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THIRD QUARTERLY AMBIENT AIR MONITORING REPORT LIVINGSTON RAIL YARD

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THIRD QUARTERLY AMBIENT AIR MONITORING REPORT LIVINGSTON RAIL YARD

Submitted to:

**Montana Department of Health
and Environmental Sciences**
Cogswell Building
Helena, Montana 59620

Submitted by:

Burlington Northern Railroad Co.
9401 Indian Creek Parkway
Overland Park, Kansas 66201

Prepared by:

Envirocon, Inc.
P.O. Box 8243
Missoula, Montana 59807

Submittal date:

October 11, 1991

ENVIROCON, INC.

1.0 INTRODUCTION

This document presents the third quarter results of Burlington Northern Railroad's (BNRR) ambient monitoring investigations, conducted by Envirocon, Inc., for the Livingston rail yard project, in Livingston, Montana. The purpose of ambient air monitoring is to assess the impact of existing site contamination and remedial activities on ambient air quality. Ambient air monitoring data collection began on November 10, 1990 and will be conducted until November 1991. This third quarterly report represents the period between April 1, 1991 and June 30, 1991.

The design and operation of the ambient air monitoring program are in accordance with the Interim Remedial Measures Work Plan (IRMWP), as amended. Envirocon is responsible for its daily operations. Bison Engineering, Inc. provides assistance by conducting audits, performing the laboratory work, and assisting with quarterly-report data preparation.

2.0 NETWORK CONFIGURATION

2.1 Monitoring Locations - General

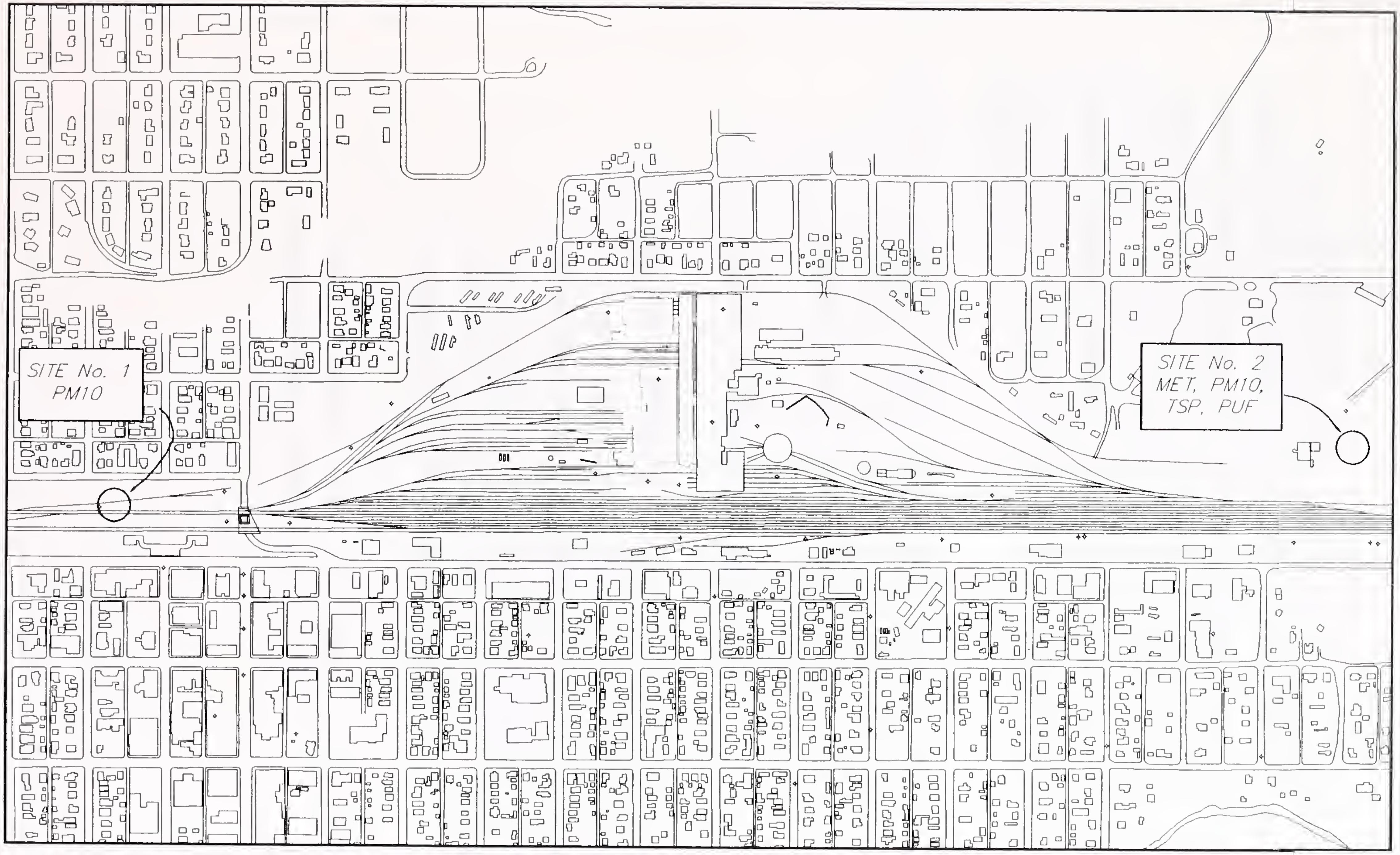
The ambient air monitoring network consists of an upwind station and a downwind station. Each station contains a PM10 air monitoring instrument. The downwind station also contains meteorological equipment, a total suspended particulate (TSP) sampler (not presently in use), and a polynuclear aromatic hydrocarbon (PAH) sampler. PAH sampling and metal measurements were only required during the first six sampling events of the first quarter and TSP sampling was terminated at the end of June 1991, following MDHES' approval.

The upwind station measures ambient air quality upwind of all remedial activities. The downwind station is located to measure worst-case ambient air impacted by remediation activities. In addition, ambient air at the downwind station is impacted by current rail yard operations. Figure 1.0 shows the locations of both stations. The coordinate locations of these sites are shown on Table 1.0.

Table 1.0
Ambient Monitoring Locations

Station	UTM East	UTM North	East Latitude	West Longitude
Upwind	334050	5056410	45° 38' 36"	110° 33' 26"
Downwind	335360	5057520	45° 39' 13"	110° 32' 47"

UTM ZONE = 12



BURLINGTON NORTHERN

ENVIROCON, INC.

AMBIENT AIR
MONITORING REPORT

SUBMITTED: JUNE 3, 1991

140101

UPWIND & DOWNWIND AMBIENT
AIR MONITORING LOCATIONS

5/31/91

FIGURE 1.0

AutoCAD FILE: DM1.DWG

2.2 Monitoring Parameters

The ambient air monitoring system is designed to measure PM10, TSP, PAHs, and airborne metals. PAH sampling was conducted during the first six sample rounds at the downwind station. Analyses for metals were conducted during the first six sample rounds and metals were measured in both the upwind and downwind PM10 filter samples. These results were presented in the first Quarterly Ambient Air Monitoring Report. The following is a list of the parameters measured and the analytical methodologies used during the third quarter:

- PM10 - PM10 is particulate matter with an aerodynamic diameter of less than 10 microns. Both the upwind and downwind stations have PM10 samplers.

  Method: 40 CFR Part 50, Appendix J.

- TSP - While PM10 provides a health-basis comparison for human exposure to particulates, PM10 does not include all particulates suspended in the atmosphere. A TSP high-volume sampler is used for this collection. The data may be compared with an earlier, out-dated air quality standard for TSP. That standard was changed in 1987 to a PM10 methodology.

  Method: Sections 1.11.1, 2.1.1, and 2.1.1.1 of the Montana Air Quality Bureau Quality Assurance Manual.

- Meteorology - A meteorological tower was constructed at the downwind site in order to assess what meteorological events may lead to the increase or decrease of ambient air pollutants. The station recorded wind speed, wind direction, temperature, and wind sigma (standard deviation of the wind direction).

  Method: Anemometer cup, wind vane, thermocouple, and computer data acquisition system. (Ambient Monitoring Guidelines for Prevention of Significant Deterioration [PSD], Section 6, EPA, EPA-450/4-87-007).

2.3 Monitoring Frequency

The monitoring frequency for each parameter is shown on Table 2.0.

Table 2.0

Ambient Monitoring Frequency

PM10	One-day-in-six, 24-hour sample Upwind and downwind stations
TSP	One-day-in-six, 24-hour sample Downwind station only
Meteorology	Continuous sampling Hourly data analysis Downwind station only

3.0 DATA SUMMARY

3.1 PM10

Fifteen PM10 samples were collected at the upwind station and 13 PM10 samples were collected at the downwind station between April 1 and June 30, 1991. The mean PM10 values for this period were 18 ug/m^3 at the upwind station and 15 ug/m^3 at the downwind station. The peak PM10 reporting values for the upwind and downwind stations were 40 and 34 ug/m^3, respectively. These values are compared against the Montana ambient air quality standards on Table 3.0.

Table 3.0
PM10 Results vs Ambient Standards

	Standard	Upwind Station	Downwind Station
Arithmetic Mean	50*	18	15
Peak	150**	40	34

Units: ug/m^3
* Annual mean
** Not to be exceeded more than once per year

Complete PM10 data and summary statistics are provided in Appendix A. The statistics include monthly means, yearly means to-date, geometric means and standard deviations. Appendix B contains the results of calibrations, audits, and precision checks.

3.2 TSP

One TSP sampler was operated at the downwind monitoring station. Fifteen samples were collected between April 1 and June 30, 1991. The mean TSP value for this period was 33 ug/m^3 and the peak value was 67 ug/m^3. These values are compared against Montana's outdated ambient air quality standards on Table 4.0.

Table 4.0
TSP Results vs Outdated Ambient Standards

	Standard	Downwind Station
Arithmetic Mean	75*	33
Peak	260**	67

Units: ug/m^3
* Annual mean
** Not to be exceeded more than once per year

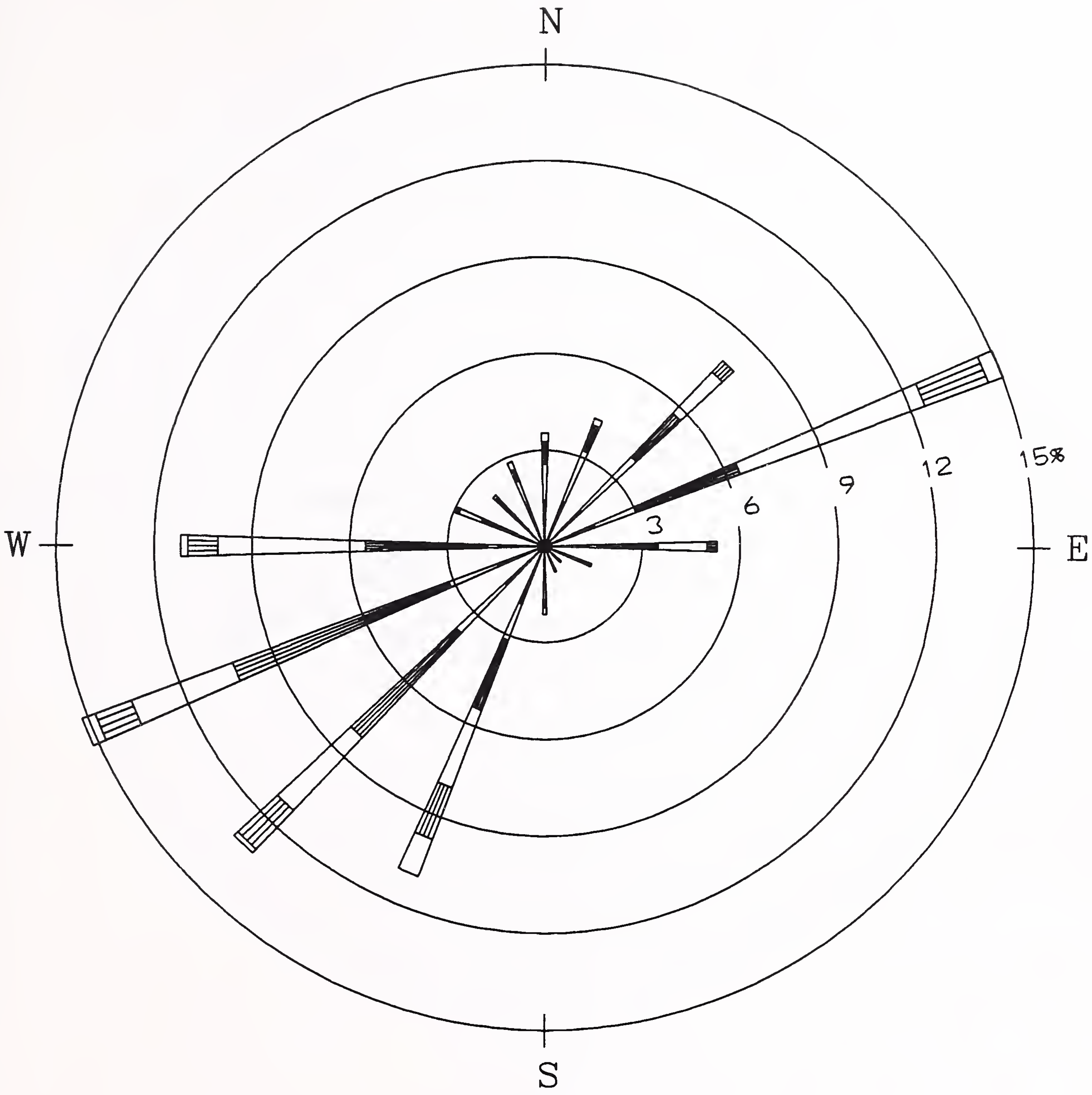
Complete TSP data and summary statistics are in Appendix A. The statistics include monthly means, yearly means to-date, geometric means and standard deviations. Appendix B provides quality control information, including calibration and audit results.

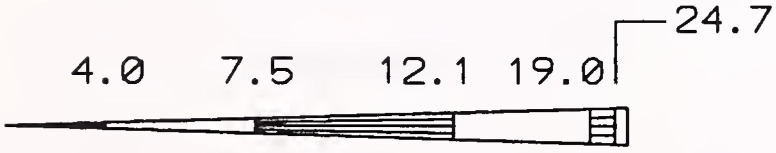
3.3 Meteorology

The meteorological station at the downwind site measures wind speed, wind direction, temperature, and wind sigma. Overall data recovery for the meteorological system was good during the third quarter of operation. Data for seven days in May and five days in June are missing due to a corrupted data file. The data are not recoverable.

Between April 1 and June 30, 1991, the average wind speed was 10.9 miles per hour, the resultant wind direction was 213 degrees, and the percentage of calm hours was 0.0 percent. The maximum temperature during this period was 86° F, the minimum temperature was 23° F, and the average temperature was 49° F.

Appendix A contains a complete listing of the meteorological information for wind speed, direction, temperature, and sigma. Appendix A also contains monthly and seasonal wind-frequency distribution data. Wind roses are shown on Figures 2.0 through 5.0.





Wind Speed Class Boundaries
(Miles/Hour)

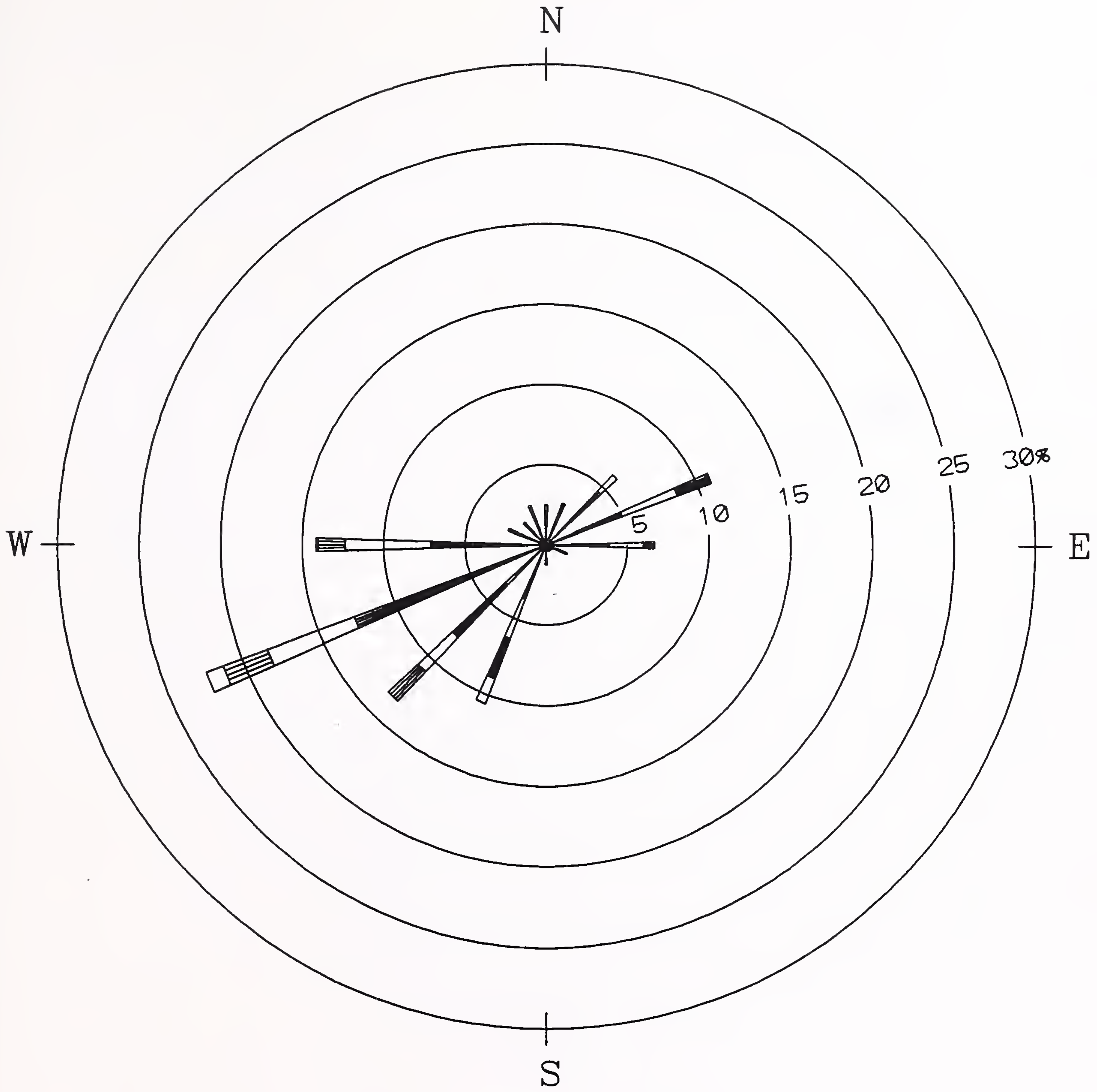
NOTES:
Diagram of the Frequency of Occurrence for each Wind Direction. Wind Direction is the Direction From Which the Wind is Blowing.

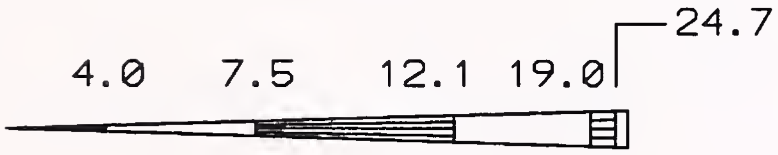
WINDROSE

Livingston Railyard
PERIOD: 2nd Q 1991

Figure 2.0

Bison
Engineering





Wind Speed Class Boundaries
(Miles/Hour)

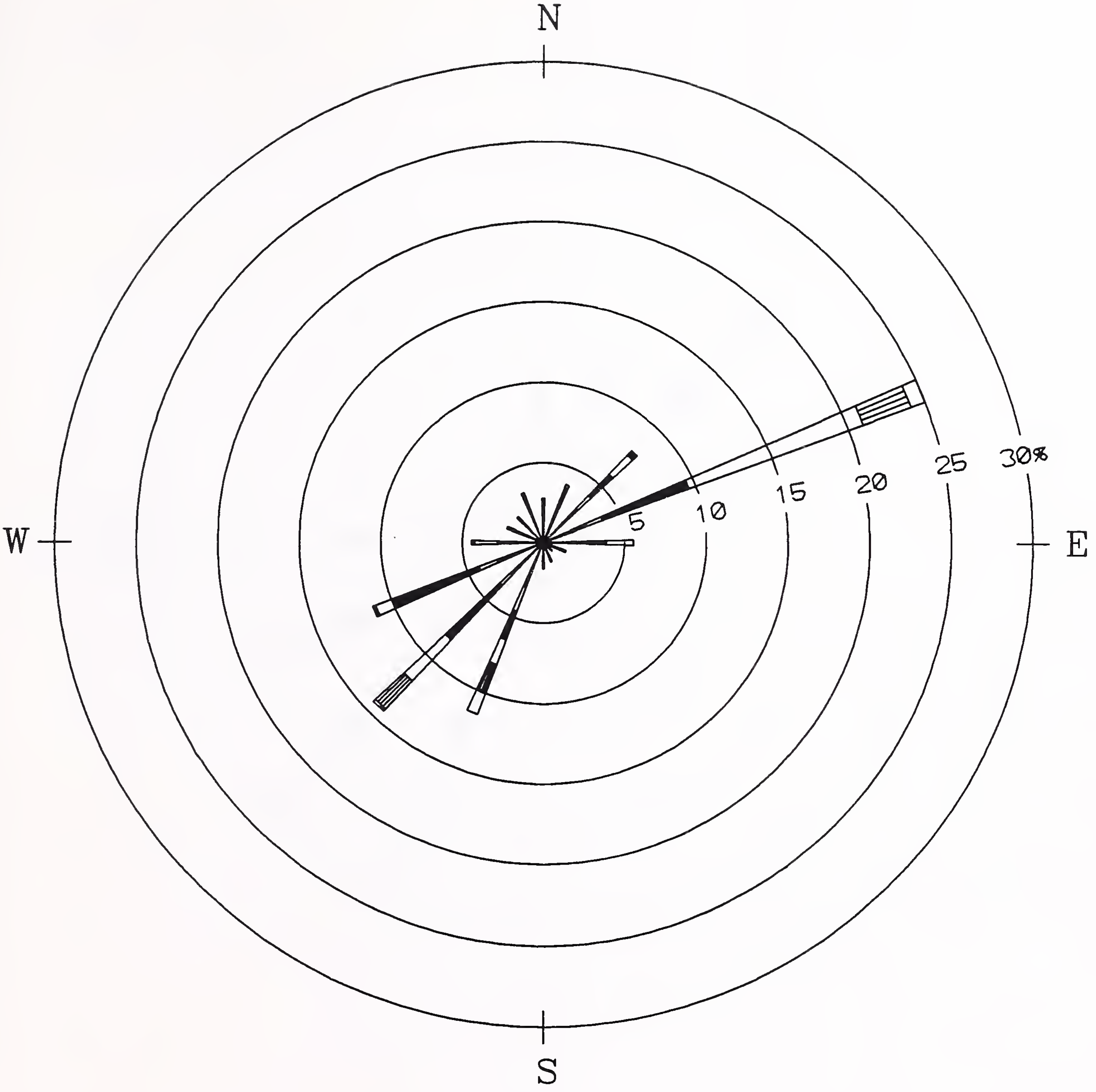
NOTES:
Diagram of the Frequency of
Occurrence for each Wind Direction.
Wind Direction is the Direction
From Which the Wind is Blowing.

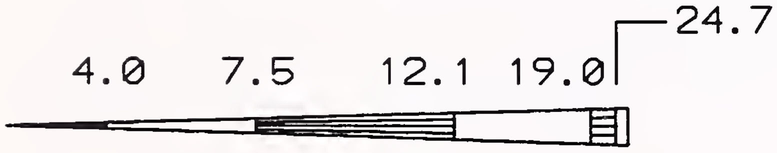
WINDROSE

Livingston Railyard
PERIOD: April 1991

Figure 3.0

Bison
Engineering





Wind Speed Class Boundaries
(Miles/Hour)

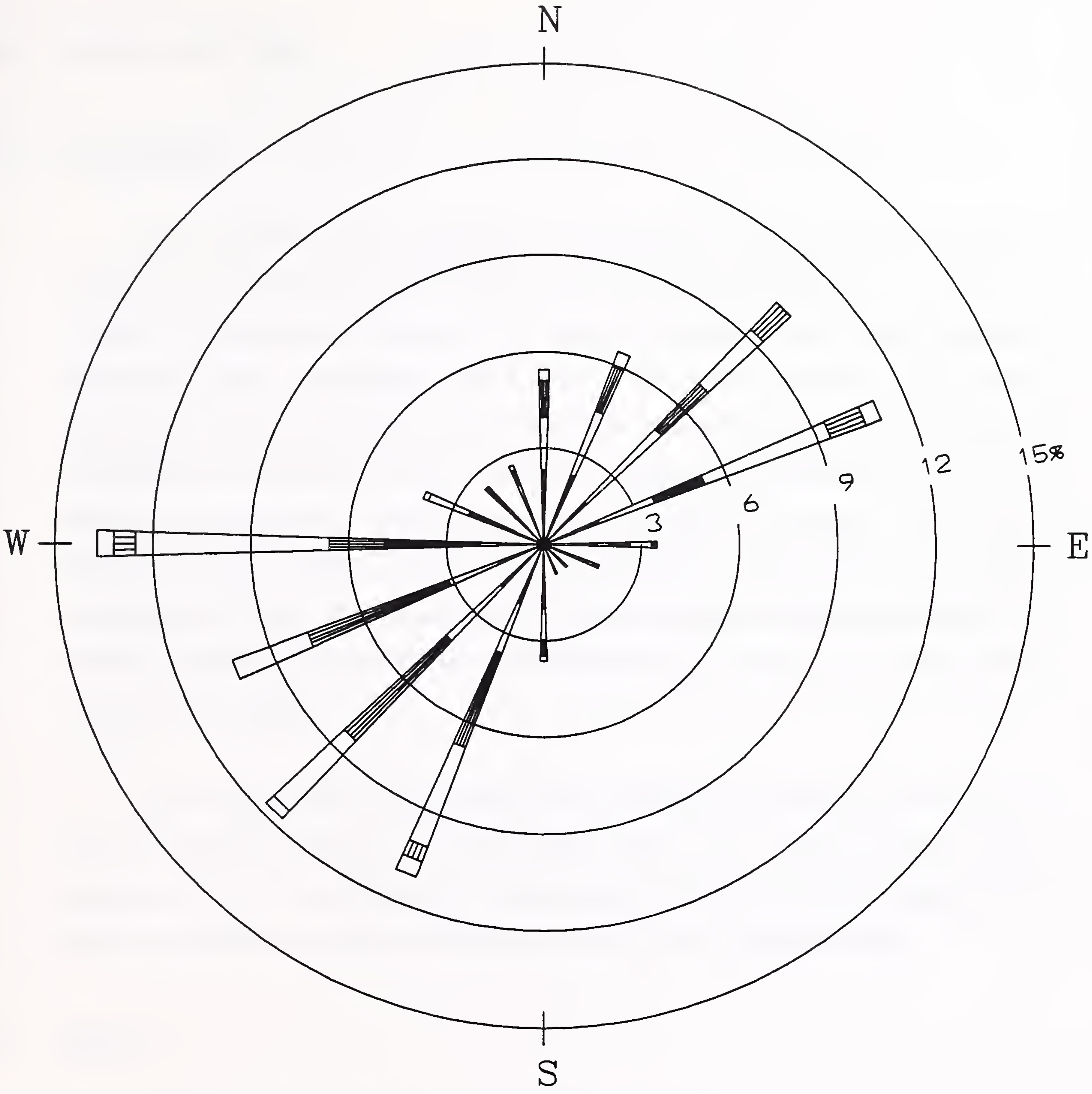
NOTES:
Diagram of the Frequency of Occurrence for each Wind Direction. Wind Direction is the Direction From Which the Wind is Blowing.

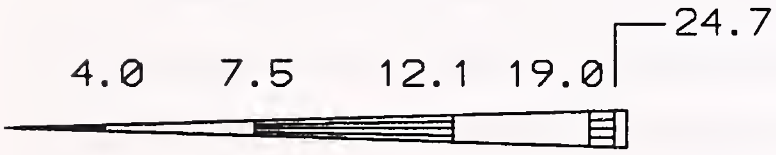
WINDROSE

Livingston Railyard
PERIOD: May 1991

Figure 4.0

Bison
Engineering





Wind Speed Class Boundaries
(Miles/Hour)

NOTES:
Diagram of the Frequency of
Occurrence for each Wind Direction.
Wind Direction is the Direction
From Which the Wind is Blowing.

WINDROSE

Livingston Railyard
PERIOD: June 1991

Figure 5.0

Bison
Engineering

4.0 DATA ANALYSIS

4.1 Introduction

The purpose of the ambient air monitoring network is to assess the impacts of existing site contamination and remedial activities on ambient air quality. However, the ambient air monitoring network can not distinguish between sources associated with previous site contamination and sources associated with current industrial operations. The first step of assessment is to measure parameters which could be reasonably expected to enter the ambient atmosphere. These parameters, defined by Section 14.4 of the IRMWP, include PM10, TSP, metals, and PAHs. The second step of the assessment is to compare these results with previously established ambient air quality standards. The final step of assessment is to compare the results with background results.

This report does not provide the investigative details for each of the above activities; however, it does assess some of the characteristics of the results to date. The following is a discussion of PM10 and TSP results. The metal and PAH results were discussed in the first quarterly report.

4.2 PM10

Section 3.0 of this report provides a comparison between the collected PM10 values and the Montana and EPA ambient air quality standards. The results indicate values well below these standards. All information collected to date indicates that the standards will not be exceeded. Envirocon compared the upwind and downwind PM10 data, and the results of this investigation are provided on Table 5.0.

Table 5.0

Upwind/Downwind PM10 Comparison

SAMPLE DATE	UPWIND	DOWNWIND	DIFFERENCE
4/6/91	12	11	1
4/12/91	1[illegible]	6	7
4/18/91	10	5	5
4/24/91	18	18	1
4/30/91	22	22	0
5/6/91	18	16	2
5/12/91	12	6	6
5/18/91	13	18	7
5/24/91	22	15	7
5/30/91	16	N/A	
6/6/91	18	N/A	
6/11/91	28	34	-6
6/17/91	18	18	-7
6/24/91	21	16	[illegible]
6/30/91	10	18	-8

Units: Micrograms/cubic meter

Two statistical tests were applied to the data. The tests (paired and unpaired t tests) were designed to assess whether or not there is enough evidence to reject the null hypothesis that the two means are the same. The results of these tests are summarized on Table 6.0.

Table 6.0

Summary Statistics

UPWIND	Mean: Std Dev: No. of Samples:	16.47 6.53 15
DOWNWIND	Mean: Std Dev: No. of Samples:	15.38 7.61 13
DIFFERENCE	Mean: Std Dev: No. of Samples:	0.92 4.92 13

Comparison of Upwind and Downwind Means

Paired Difference t-test:

t = Mean/(S/(n)^.5) Where S = standard deviation

t = 0.68

Critical t (95%) = 2.17

Unpaired t-test:

$t = (\text{mean}_1 - \text{mean}_2)/(S*(1/n_1+1/n_2)\verb|^|.5)$ where S = pooled std. dev.

t = 0.44

Critical t (95%) = 2.12

Since both t values fall within their respective 95-percent two-tailed confidence intervals (as defined by the critical t values), not enough evidence exists to reject the null hypothesis. Therefore, there is no difference in the mean and mean-difference PM10 values between the two monitoring sites.

4.3 TSP

The results of TSP sampling to date indicate values well below the outdated ambient air quality standard. These results are shown in Section 3.0 of this report.

APPENDIX A

ENVIROCON, INC.

Bison Engineering Inc

Helena, MT 59601

PM10 Particulate Summary

1991 Site & Area: 1111 3

Upwind Site Livingston, MT Envirocon

(Values are in Micrograms per Cubic Meter)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	19	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	15	-	-	-	-	-	-	-	-	-	-
6	-	-	-	12	18	19	-	-	-	-	-	-
7	-	-	12	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	19	-	-	-	28	-	-	-	-	-	-
12	14	-	-	13	12	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	39	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	9	-	-	-	12	-	-	-	-	-	-
18	13	-	-	10	13	-	-	-	-	-	-	-
19	-	-	40	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	15	-	-	-	-	-	-	-	-	-	-
24	15	-	-	19	22	21	-	-	-	-	-	-
25	-	-	13	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-
30	22	-	-	22	16	10	-	-	-	-	-	-
31	-	-	16	-	-	-	-	-	-	-	-	-
No.	4	4	6	5	5	5	0	0	0	0	0	0
Max	22	19	40	22	22	28						
Avg	16	15	23	15	16	18						

Bison Engineering Inc

Helena, MT 59601

PM10 Particulate Summary

1991 Site & Area: 1111 4

Downwind Site Livingston, MT Envirocon

(Values are in Micrograms per Cubic Meter)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	8	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	12	-	-	-	-	-	-	-	-	-	-
6	17	-	-	11	16	-	-	-	-	-	-	-
7	-	-	15	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	18	-	-	-	34	-	-	-	-	-	-
12	-	-	-	6	6	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	28	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	14	-	-	-	19	-	-	-	-	-	-
18	13	-	-	5	11	-	-	-	-	-	-	-
19	-	-	20	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	13	-	-	-	-	-	-	-	-	-	-
24	9	-	-	19	15	18	-	-	-	-	-	-
25	-	-	8	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-
30	24	-	-	22	-	18	-	-	-	-	-	-
31	-	-	15	-	-	-	-	-	-	-	-	-
No.	4	4	6	5	4	4	0	0	0	0	0	0
Max	24	18	28	22	16	34						
Avg	16	14	16	13	12	22						

Bison Engineering Inc.
Helena, MT 59601

SUMMARY STATISTICS FOR THE PM10 PARTICULATE DATA

1991

Livingston, MT Envirocon

Site #	Min	Max	2nd Max	# > 150	Arith. Mean	Arith. Std Dev	Geo. Mean	Geo. Std Dev	Total # Obs.
3	9	40	39	0	18	8	16	1.4	29
4	5	34	28	0	15	7	14	1.6	27

Bison Engineering Inc

Helena, MT 59601

Total Suspended Particulate Summary

1991 Site & Area: 1111 4

Downwind Site Livingston, MT Envirocon

(Values are in Micrograms per Cubic Meter)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	20	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	30	-	-	-	-	-	-	-	-	-	-
6	33	-	-	22	25	19	-	-	-	-	-	-
7	-	-	29	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	61	-	-	-	67	-	-	-	-	-	-
12	42	-	-	9	23	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	40	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	37	-	-	-	41	-	-	-	-	-	-
18	37	-	-	7	28	-	-	-	-	-	-	-
19	-	-	43	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	30	-	-	-	-	-	-	-	-	-	-
24	17	-	-	48	27	38	-	-	-	-	-	-
25	-	-	18	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-
30	61	-	-	39	29	35	-	-	-	-	-	-
31	-	-	39	-	-	-	-	-	-	-	-	-
No.	5	4	6	5	5	5	0	0	0	0	0	0
Max	61	61	43	48	29	67						
Avg	38	40	32	25	26	40						

Bison Engineering Inc.
Helena, MT 59601

SUMMARY STATISTICS FOR THE TSP PARTICULATE DATA

1991

Downwind Site Livingston, MT Envirocon

Site #	Min	Max	2nd Max	# > 150	Arith. Mean	Arith. Std Dev	Geo. Mean	Geo. Std Dev	Total # Obs.
4	7	67	62	0	33	14	30	1.7	30

BISON ENGINEERING INC.
HELENA, MONTANA

Envirocon Livingston, Montana APRIL 1991

*** TEMPERATURE SUMMARY (DEG F) ***

HOURS

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	48	48	46	46	46	45	45	46	50	54	57	61	64	64	66	66	66	64	61	55	54	52	50	50	54
2	46	45	45	45	45	43	45	46	48	52	57	61	63	64	63	63	57	55	52	50	41	39	41	41	50
3	41	41	41	41	41	41	39	45	46	46	50	52	52	54	55	55	57	55	54	54	52	52	52	52	49
4	50	50	52	52	52	50	52	54	55	57	59	61	64	64	64	63	64	64	63	61	61	61	61	61	58
5	59	59	59	57	57	57	59	59	61	63	64	64	64	64	64	66	66	66	61	61	57	55	54	55	61
6	55	54	54	54	48	45	43	41	39	41	41	43	39	37	36	41	41	41	39	39	36	34	34	36	42
7	34	34	32	32	30	30	32	32	34	34	34	36	34	36	34	34	32	32	32	32	32	32	32	32	33
8	30	30	30	30	30	30	30	30	32	34	36	37	37	37	39	39	37	37	37	34	32	32	32	32	34
9	30	30	30	32	34	36	36	36	36	39	41	43	45	46	43	39	41	39	37	36	36	34	36	34	37
10	34	34	32	32	30	30	28	28	30	30	30	32	32	36	37	36	37	37	36	36	36	34	34	32	33
11	30	30	30	28	28	28	28	28	28	30	32	32	34	34	32	32	32	32	30	30	30	30	28	28	30
12	28	28	28	28	28	28	28	28	28	30	30	32	34	32	32	32	30	30	30	28	28	28	28	28	30
13	28	28	28	28	27	27	27	28	28	30	32	37	36	37	37	34	32	32	30	30	30	30	30	28	31
14	28	28	30	30	30	32	34	36	37	39	41	43	45	45	46	45	45	36	34	32	32	32	32	32	36
15	30	30	30	30	30	28	32	34	32	34	36	37	36	39	39	41	41	39	39	37	36	36	36	36	35
16	34	34	32	32	30	30	30	30	32	34	34	32	32	34	34	34	34	34	32	32	32	32	32	32	32
17	32	32	32	32	32	32	32	32	34	34	36	37	37	39	39	37	37	37	37	36	36	36	34	34	35
18	34	34	34	34	34	34	34	34	36	36	36	36	36	36	36	36	36	36	34	34	34	34	34	34	35
19	32	32	32	32	32	32	34	34	39	37	39	39	41	41	41	41	41	41	39	37	36	34	34	34	36
20	32	30	30	32	34	34	36	39	41	46	50	54	55	57	59	55	54	52	48	46	43	39	37	36	43
21	34	32	32	30	28	30	34	36	43	48	52	54	54	55	55	57	57	57	55	50	48	45	41	41	45
22	39	39	39	39	39	39	41	45	46	52	55	59	61	61	63	63	63	63	61	55	50	48	48	46	51
23	46	45	45	43	43	45	46	48	50	55	59	61	63	64	64	64	64	61	61	55	54	54	52	52	54
24	50	48	48	48	46	46	48	52	54	55	57	57	54	57	57	55	55	55	54	48	46	45	41	41	51
25	39	39	39	39	39	37	39	37	34	34	34	34	36	37	39	39	39	39	39	37	37	37	37	36	37
26	36	36	34	34	32	34	34	32	34	36	37	39	41	41	43	43	45	45	43	39	37	37	36	34	37
27	34	34	32	32	32	32	34	34	34	36	36	39	39	39	37	37	37	36	36	36	37	36	36	36	35
28	36	36	36	34	34	34	36	37	37	39	39	43	46	48	48	50	48	50	48	45	41	39	37	39	41
29	36	37	37	36	34	32	32	37	39	41	41	41	43	45	46	45	43	43	41	39	37	37	36	36	39
30	36	34	34	34	34	32	32	36	37	37	39	41	43	45	45	45	46	46	46	41	37	36	32	28	38
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
AVG.	37	37	37	37	36	36	37	38	39	41	43	45	45	46	47	46	46	45	44	42	40	39	38	38	

MINIMUM T = 27 MAXIMUM T = 66 AVERAGE T = 41 HOURS OF DATA = 720

BISON ENGINEERING INC.
HELENA, MONTANA

Envirocon Livingston, Montana MAY 1991

*** TEMPERATURE SUMMARY (DEG F) ***

DAY	HOURS																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	28	27	25	23	23	23	25	30	37	41	43	45	46	46	48	48	48	46	45	41	41	39	37	37	37
2	36	32	30	30	30	30	30	30	28	30	30	30	32	32	30	30	30	30	30	30	30	30	30	28	31
3	28	28	28	28	28	28	28	28	30	32	32	34	36	36	37	37	37	37	36	36	34	34	32	32	32
4	32	32	32	32	32	32	34	36	37	37	37	37	41	43	43	45	45	45	46	43	39	37	36	34	38
5	34	32	32	36	36	37	41	43	45	48	52	54	55	55	55	55	55	57	55	55	54	54	52	50	48
6	52	50	50	46	46	46	46	48	52	54	54	55	59	59	59	59	57	52	48	48	48	46	46	45	51
7	45	45	45	45	45	45	46	48	50	52	54	54	57	52	54	55	57	59	61	59	57	55	55	55	52
8	55	54	54	54	54	55	57	55	55	61	66	70	70	70	68	63	57	48	46	45	45	45	45	43	56
9	43	43	43	43	43	43	43	43	43	43	43	43	43	41	41	41	39	39	37	37	36	34	36	36	41
10	36	36	36	36	36	36	36	37	39	39	39	39	43	43	43	45	43	43	45	45	43	43	43	43	40
11	43	43	43	43	43	43	43	43	45	45	46	48	48	50	48	48	48	48	48	46	46	45	45	45	46
12	46	45	45	43	43	43	45	46	48	48	52	54	55	57	57	54	54	52	48	46	48	48	48	50	49
13	52	52	52	52	52	52	54	54	55	57	59	61	63	63	66	64	64	64	63	61	59	57	54	54	58
14	54	52	50	46	46	46	48	50	55	57	59	59	61	59	52	52	50	50	48	46	46	46	45	45	51
15	45	43	43	43	43	45	45	46	48	48	50	50	52	54	54	54	55	55	54	52	48	46	45	43	48
16	43	43	41	39	39	39	43	46	50	54	55	59	59	61	63	63	63	63	61	59	55	54	52	50	52
17	50	48	48	48	48	48	48	50	52	54	59	63	64	64	63	61	61	61	59	57	55	54	52	52	55
18	52	50	48	48	48	48	48	48	48	50	52	52	55	59	61	61	59	57	55	54	54	52	50	48	52
19	48	46	45	45	46	45	48	48	54	59	63	66	66	66	68	68	68	68	66	63	59	55	54	52	57
20	52	50	50	48	50	50	54	57	59	61	63	63	66	68	63	73	75	75	72	68	63	59	55	52	60
21	50	50	46	45	45	46	52	55	61	66	68	72	73	73	73	73	73	72	72	68	63	59	59	55	61
22	50	48	46	45	43	45	46	54	59	63	64	66	68	68	70	70	70	70	66	64	61	57	57	55	59
23	54	57	55	55	55	54	55	59	61	66	68	70	70	72	70	-	-	-	-	-	-	-	-	-	61
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
AVG.	45	44	43	42	42	43	44	46	48	51	53	54	56	56	56	55	55	54	53	51	49	48	47	46	

MINIMUM T = 23 MAXIMUM T = 75 AVERAGE T = 49 HOURS OF DATA = 543

BISON ENGINEERING INC.
HELENA, MONTANA

Envirocon Livingston, Montana JUNE 1991

*** TEMPERATURE SUMMARY (DEG F) ***

HOURS

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	54	54	52	52	52	51
6	52	54	52	52	50	50	52	55	55	59	61	63	63	63	61	61	61	59	59	59	57	55	54	55	57
7	54	50	50	50	54	55	59	61	63	66	68	70	70	72	73	72	72	72	70	66	64	63	61	57	63
8	54	50	48	48	45	46	52	57	61	64	66	68	68	66	68	68	64	63	63	63	61	57	55	55	59
9	55	54	54	54	54	54	55	57	57	61	63	66	68	68	70	72	72	72	72	68	61	57	54	50	61
10	46	46	45	43	43	45	48	59	64	68	73	75	81	81	81	82	82	82	81	77	72	64	61	59	65
11	54	52	50	50	50	64	66	68	72	79	82	84	86	86	86	86	84	81	70	70	64	61	59	57	69
12	52	50	48	46	45	48	54	57	61	64	68	72	73	75	75	73	73	72	68	66	63	61	61	59	62
13	55	55	54	54	52	52	54	57	59	61	61	61	64	70	68	68	68	66	64	61	57	57	55	54	59
14	54	50	50	48	46	48	50	50	50	50	48	46	45	45	52	55	54	55	55	54	50	48	48	43	50
15	45	45	43	43	41	41	46	50	54	59	63	64	68	70	72	73	73	73	72	70	66	66	63	63	59
16	63	63	59	59	59	61	63	66	70	72	72	72	72	73	73	70	66	63	61	59	57	54	52	54	64
17	54	52	52	52	50	50	52	52	54	55	57	61	63	64	66	66	66	66	64	63	59	55	54	46	57
18	43	41	37	37	36	39	45	52	55	57	61	63	64	66	68	68	70	70	68	66	63	61	61	61	56
19	59	57	57	55	54	55	55	55	57	61	64	66	68	68	66	64	64	64	63	61	61	59	59	57	61
20	55	55	55	55	55	55	55	55	57	59	61	61	61	61	63	64	64	64	63	61	59	57	57	57	59
21	55	52	54	55	54	54	55	61	64	64	66	68	70	70	68	68	68	66	66	64	61	59	57	55	61
22	54	54	54	54	54	54	54	55	59	63	63	64	64	68	64	61	63	63	63	59	57	54	52	50	58
23	50	46	45	45	45	46	52	55	59	63	66	68	72	73	70	70	70	68	66	64	61	59	55	54	59
24	52	54	54	54	52	52	55	57	59	64	66	70	72	70	70	70	66	66	64	63	63	61	59	57	61
25	57	57	57	55	54	52	52	55	57	63	63	64	66	59	63	64	66	66	64	61	57	57	55	55	59
26	54	54	52	52	50	52	54	57	59	64	66	61	59	61	63	59	57	57	57	57	55	55	55	54	57
27	54	52	52	52	50	50	54	55	57	63	66	68	68	68	68	66	64	63	63	63	59	57	55	55	59
28	55	55	55	55	55	52	54	59	61	63	64	66	66	70	70	70	72	72	72	70	63	59	54	52	62
29	48	46	46	46	46	46	48	54	55	59	64	64	68	70	75	72	72	70	68	66	64	63	59	57	60
30	55	54	55	55	55	55	54	54	55	59	61	61	63	64	68	68	66	66	64	63	59	59	57	57	60
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
AVG.	53	52	51	51	50	51	53	57	59	62	65	66	67	68	69	68	68	67	65	63	60	58	56	55	

MINIMUM T = 36 MAXIMUM T = 86 AVERAGE T = 60 HOURS OF DATA = 606

BISON ENGINEERING INC.
HELENA, MONTANA

Envirocon　　Livingston, Montana　　APRIL 1991

*** *WIND SIGMA SUMMARY (DEGREES)* ***

DAY	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	10	11	10	11	11	10	11	14	20	19	13	12	23	44	39	34	29	15	27	9	59	51	12	11	21
2	16	19	24	14	15	13	12	11	11	10	16	30	37	29	21	23	10	32	38	10	9	13	12	14	18
3	13	14	14	13	21	12	13	15	10	13	11	10	11	12	14	12	12	15	11	12	11	12	11	12	13
4	11	13	13	16	13	11	13	11	12	11	13	12	13	16	13	14	12	12	12	12	11	12	11	11	12
5	12	12	12	11	11	11	11	12	12	11	11	10	11	10	12	13	15	16	9	8	9	10	18	9	12
6	9	8	7	19	9	36	35	27	13	14	61	33	27	52	80	37	12	22	10	14	55	21	37	28	28
7	18	48	83	65	58	63	26	27	28	30	77	42	46	47	43	15	16	10	12	14	10	10	11	12	34
8	15	12	12	11	10	11	12	11	12	11	11	12	13	16	15	14	16	15	12	13	8	15	16	30	13
9	10	27	51	18	16	13	11	11	13	12	12	12	12	12	34	16	12	9	11	58	47	66	48	77	25
10	33	50	15	8	9	8	9	8	8	11	9	10	13	14	19	11	12	13	9	11	14	21	17	25	15
11	9	8	8	8	8	9	13	17	32	57	10	10	9	9	9	9	8	8	8	8	8	8	8	8	12
12	8	9	8	9	10	9	10	10	8	9	9	12	11	9	10	15	11	10	25	12	15	16	16	15	12
13	14	20	37	11	16	13	11	16	13	18	19	32	59	51	23	12	14	39	29	61	24	70	22	47	28
14	31	23	22	28	18	13	15	13	14	11	12	15	17	14	11	8	18	14	21	15	31	37	7	76	20
15	45	74	38	69	26	18	44	48	18	14	15	14	13	19	12	20	12	14	10	14	10	12	10	10	24
16	12	10	10	10	9	11	10	10	9	8	8	8	9	9	10	10	9	9	10	9	9	10	10	10	10
17	9	10	10	10	9	10	10	9	11	11	10	9	11	10	13	13	11	10	14	11	10	12	13	24	11
18	15	15	20	18	14	24	17	11	11	9	11	15	10	11	12	10	12	10	9	10	13	14	14	13	13
19	23	21	36	49	22	22	23	28	79	49	56	17	16	17	17	17	19	13	13	14	15	46	21	43	28
20	43	68	55	61	18	11	10	19	12	14	15	43	69	55	48	35	10	10	22	22	27	47	52	82	35
21	70	32	68	51	21	23	45	32	35	58	56	21	15	15	15	15	15	13	14	45	82	40	52	77	38
22	54	34	25	10	11	10	10	11	11	10	18	32	30	22	35	21	21	19	13	18	11	36	13	10	20
23	11	14	8	9	11	12	12	17	12	15	16	12	16	28	40	21	19	19	15	57	58	11	11	14	19
24	17	16	23	14	12	9	10	11	11	12	14	19	13	16	38	11	11	12	33	8	9	9	45	53	18
25	55	23	50	58	27	13	44	32	17	32	44	9	11	10	36	45	13	10	9	11	11	9	8	10	24
26	8	8	13	9	11	11	8	9	11	13	37	14	15	16	13	12	15	13	20	13	10	9	10	9	13
27	10	11	13	10	11	10	11	8	11	11	11	12	11	11	10	11	11	11	9	10	12	10	11	10	11
28	11	10	10	10	11	10	10	10	11	9	9	10	11	13	15	14	20	15	17	15	28	13	18	9	13
29	7	18	10	9	76	69	55	15	46	18	18	17	13	18	18	19	48	13	12	16	12	15	12	23	24
30	44	10	10	12	24	16	9	22	22	19	23	15	27	27	48	45	24	44	21	13	45	23	66	66	28
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
AVG.	21	22	24	22	18	17	18	17	18	18	22	17	20	21	24	18	16	16	16	18	22	23	20	28	

BISON ENGINEERING INC.
HELENA, MONTANA

Envirocon Livingston, Montana MAY 1991

*** WIND SIGMA SUMMARY (DEGREES) ***

HOURS

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	72	55	10	17	26	56	23	38	37	24	14	14	12	13	14	14	11	11	11	12	17	12	12	9	22
2	12	14	15	10	11	10	10	10	14	10	11	11	11	9	10	10	10	9	10	11	9	9	10	11	11
3	9	9	10	10	10	11	9	8	10	11	10	11	11	12	14	14	14	12	9	13	16	15	18	17	12
4	20	48	13	12	10	36	65	30	68	64	22	21	42	41	55	32	25	36	19	35	22	21	75	29	35
5	63	54	82	8	8	11	17	15	10	12	24	15	17	18	14	14	15	14	14	17	18	16	19	17	21
6	19	12	58	67	30	17	12	8	43	41	30	38	66	24	35	45	44	23	12	10	15	12	19	23	29
7	15	17	15	14	10	12	16	15	22	16	16	34	17	13	21	19	48	21	14	17	14	11	13	13	18
8	12	15	19	60	83	67	72	35	16	15	47	13	13	13	15	18	29	10	26	23	14	15	14	12	27
9	22	15	18	15	14	35	15	63	41	24	40	33	74	43	21	14	15	12	23	16	28	71	83	34	32
10	32	81	24	70	55	32	22	64	34	15	15	18	11	10	10	11	9	9	10	11	16	17	16	16	25
11	15	25	33	38	19	66	55	50	15	12	13	16	13	12	10	45	16	55	45	66	24	14	12	16	29
12	11	13	12	12	12	16	21	15	16	13	16	19	18	15	25	11	24	10	26	20	13	13	14	12	16
13	12	11	13	15	12	12	15	11	11	12	11	12	15	12	17	12	12	13	12	16	15	24	13	14	13
14	19	64	18	61	16	25	28	33	38	35	34	23	18	22	28	15	13	21	40	64	51	56	14	20	32
15	37	41	25	51	37	40	12	29	25	27	16	16	53	38	41	15	15	14	14	16	13	18	71	16	28
16	11	14	86	39	57	34	15	19	21	24	18	15	14	12	13	12	11	10	10	9	8	9	11	21	21
17	23	18	25	27	34	22	20	14	13	26	11	12	11	10	11	11	10	10	11	13	11	12	12	10	16
18	36	54	16	24	65	17	13	11	9	11	13	13	14	13	11	11	11	40	13	18	18	11	14	31	20
19	68	30	16	17	71	45	14	39	71	61	60	48	31	19	17	14	13	13	12	42	64	50	72	62	40
20	80	46	15	61	72	50	17	11	11	11	14	15	18	17	26	70	14	30	24	56	58	49	37	29	35
21	27	20	80	49	64	41	53	57	34	69	34	81	20	26	14	13	10	10	12	45	31	35	70	69	40
22	31	58	19	64	68	46	25	58	54	55	19	16	15	16	13	12	12	12	10	17	17	28	72	36	32
23	12	20	15	19	15	13	19	13	12	79	33	36	38	34	25	56	-	-	-	-	-	-	-	-	27
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
AVG.	29	32	28	33	35	31	25	28	27	29	23	23	24	19	20	21	17	18	17	25	22	24	31	24	

BISON ENGINEERING INC.
HELENA, MONTANA

Envirocon Livingston, Montana JUNE 1991

*** WIND SIGMA SUMMARY (DEGREES) ***

HOURS

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	46	77	37	53	29	50
6	25	69	60	46	57	66	81	18	22	20	23	17	17	18	14	13	10	18	18	14	17	38	59	15	31
7	60	33	70	64	24	11	78	28	14	34	39	27	34	25	41	28	14	12	11	10	13	28	30	47	32
8	30	58	38	13	68	43	47	23	33	45	42	55	15	11	13	22	36	14	14	16	22	13	13	14	29
9	16	15	55	22	40	82	37	22	10	15	23	43	15	14	12	22	21	64	22	49	29	12	39	80	32
10	36	28	73	46	25	23	61	34	20	14	12	16	24	22	11	12	13	11	9	8	61	16	76	75	30
11	22	77	35	19	63	33	34	24	16	12	12	12	14	12	12	15	14	39	15	23	56	42	21	47	28
12	84	17	22	47	32	46	38	49	38	37	38	51	41	39	41	29	50	80	57	41	50	24	61	37	44
13	58	52	49	37	65	60	79	63	45	71	26	28	51	71	60	32	23	14	11	11	20	17	15	12	40
14	20	70	48	35	48	51	28	36	45	20	36	53	22	13	36	17	12	11	13	12	9	14	21	14	29
15	10	9	10	11	8	9	15	12	16	28	43	23	23	37	48	33	14	13	19	11	12	21	25	14	19
16	83	52	69	74	64	35	36	18	29	11	13	16	30	16	18	36	18	16	68	35	79	73	89	41	42
17	57	24	34	18	32	38	15	29	24	12	13	12	10	10	13	11	13	16	21	34	26	54	77	32	26
18	18	60	30	64	48	53	25	63	29	25	32	17	16	15	15	13	13	11	12	13	15	32	11	10	27
19	17	37	47	19	73	55	41	18	16	16	13	15	12	12	12	12	11	11	11	10	10	11	11	10	21
20	10	11	11	14	13	11	10	12	11	12	14	19	20	10	11	11	12	11	10	12	12	30	29	53	15
21	88	23	18	14	10	12	14	32	73	52	22	26	21	17	12	15	16	16	15	20	19	20	10	10	24
22	11	10	11	25	14	15	14	19	73	70	77	47	38	34	24	66	84	30	13	61	77	29	71	63	41
23	59	78	79	36	39	39	43	50	22	73	27	34	27	27	18	15	22	37	22	57	50	44	35	59	41
24	25	34	25	35	26	44	37	38	28	63	64	59	52	15	21	19	31	18	11	14	18	55	11	12	31
25	15	14	25	27	27	62	39	32	14	37	11	10	14	24	15	13	17	17	21	16	21	14	16	17	22
26	16	19	17	14	15	12	12	14	16	36	61	41	13	14	14	14	33	18	20	21	25	14	15	18	21
27	10	13	11	13	82	18	19	12	12	43	47	34	17	17	13	26	13	40	71	46	75	29	67	44	32
28	46	14	38	78	11	14	13	31	14	14	22	23	22	19	18	20	20	18	25	23	68	58	64	60	31
29	79	38	34	70	88	51	30	42	39	31	50	44	66	81	41	38	53	17	17	12	28	16	15	15	41
30	40	52	31	45	9	9	10	13	11	11	11	11	14	19	14	15	13	16	14	18	20	17	21	9	18
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
AVG.	37	36	38	35	39	36	34	29	27	32	31	29	25	24	22	22	23	23	23	24	35	29	37	32	

BISON ENGINEERING INC.
HELENA, MONTANA

APRIL 1991

*** *WIND SPEED SUMMARY* ***

DAY	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	12.0	13.0	15.0	16.0	15.0	17.0	16.0	15.0	10.0	13.0	12.0	14.0	10.0	7.0	6.0	7.0	6.0	6.0	6.0	8.0	5.0	5.0	8.0	10.0	10.5
2	11.0	9.0	7.0	10.0	11.0	11.0	11.0	12.0	12.0	12.0	11.0	9.0	8.0	10.0	15.0	18.0	20.0	11.0	5.0	19.0	25.0	16.0	10.0	11.0	12.3
3	11.0	13.0	10.0	10.0	8.0	11.0	11.0	14.0	16.0	17.0	19.0	22.0	22.0	22.0	23.0	21.0	19.0	15.0	19.0	19.0	18.0	20.0	25.0	24.0	17.0
4	24.0	23.0	19.0	17.0	23.0	22.0	20.0	22.0	29.0	28.0	25.0	27.0	21.0	20.0	24.0	24.0	22.0	23.0	24.0	21.0	21.0	20.0	23.0	25.0	22.8
5	21.0	20.0	21.0	17.0	16.0	19.0	21.0	24.0	25.0	28.0	30.0	31.0	33.0	30.0	28.0	25.0	22.0	18.0	20.0	16.0	13.0	14.0	12.0	16.0	21.7
6	13.0	13.0	15.0	17.0	11.0	7.0	3.0	4.0	6.0	7.0	3.0	7.0	15.0	8.0	4.0	10.0	12.0	11.0	10.0	10.0	5.0	3.0	5.0	7.0	8.6
7	7.0	6.0	2.0	3.0	1.0	2.0	3.0	4.0	6.0	6.0	1.0	2.0	5.0	3.0	2.0	4.0	15.0	19.0	12.0	11.0	12.0	11.0	13.0	14.0	6.8
8	12.0	12.0	11.0	11.0	14.0	15.0	10.0	11.0	12.0	14.0	16.0	17.0	16.0	14.0	15.0	16.0	14.0	10.0	9.0	8.0	7.0	8.0	8.0	8.0	12.0
9	14.0	10.0	7.0	12.0	16.0	19.0	18.0	21.0	21.0	23.0	23.0	22.0	23.0	22.0	19.0	12.0	17.0	16.0	13.0	6.0	7.0	4.0	5.0	3.0	14.7
10	3.0	5.0	11.0	15.0	17.0	16.0	15.0	16.0	16.0	14.0	17.0	18.0	15.0	13.0	11.0	14.0	12.0	12.0	12.0	11.0	9.0	6.0	7.0	10.0	12.3
11	14.0	17.0	18.0	20.0	21.0	18.0	15.0	13.0	7.0	6.0	16.0	21.0	21.0	22.0	20.0	17.0	18.0	20.0	21.0	20.0	20.0	22.0	20.0	15.0	17.6
12	18.0	19.0	19.0	19.0	17.0	19.0	16.0	18.0	21.0	21.0	16.0	20.0	18.0	21.0	18.0	15.0	15.0	15.0	9.0	10.0	6.0	5.0	8.0	7.0	15.4
13	6.0	7.0	8.0	13.0	10.0	11.0	9.0	7.0	7.0	7.0	7.0	6.0	5.0	4.0	3.0	8.0	6.0	4.0	2.0	2.0	2.0	1.0	5.0	4.0	6.0
14	2.0	1.0	2.0	6.0	7.0	11.0	10.0	11.0	12.0	13.0	11.0	10.0	11.0	11.0	12.0	11.0	10.0	10.0	8.0	6.0	5.0	3.0	3.0	1.0	7.8
15	3.0	2.0	3.0	2.0	3.0	4.0	3.0	4.0	6.0	8.0	9.0	9.0	11.0	10.0	10.0	8.0	11.0	11.0	11.0	13.0	11.0	13.0	15.0	13.0	8.0
16	14.0	14.0	13.0	13.0	13.0	15.0	16.0	18.0	21.0	24.0	24.0	26.0	22.0	22.0	20.0	18.0	16.0	15.0	14.0	13.0	11.0	12.0	13.0	13.0	16.7
17	13.0	11.0	11.0	12.0	13.0	13.0	10.0	10.0	10.0	13.0	13.0	15.0	15.0	15.0	15.0	13.0	13.0	12.0	10.0	10.0	11.0	11.0	10.0	8.0	12.0
18	9.0	7.0	5.0	7.0	7.0	8.0	8.0	7.0	10.0	12.0	12.0	10.0	11.0	10.0	12.0	12.0	8.0	11.0	12.0	11.0	9.0	6.0	5.0	6.0	9.0
19	3.0	1.0	2.0	1.0	1.0	2.0	3.0	3.0	2.0	2.0	4.0	8.0	9.0	9.0	7.0	7.0	7.0	8.0	7.0	4.0	5.0	3.0	2.0	2.0	4.3
20	3.0	2.0	2.0	4.0	6.0	10.0	10.0	14.0	12.0	11.0	10.0	5.0	5.0	6.0	5.0	12.0	15.0	14.0	8.0	9.0	5.0	1.0	2.0	2.0	7.2
21	1.0	1.0	1.0	1.0	2.0	3.0	3.0	2.0	1.0	2.0	4.0	10.0	12.0	12.0	11.0	10.0	10.0	9.0	6.0	4.0	3.0	3.0	3.0	2.0	4.8
22	2.0	4.0	6.0	11.0	12.0	11.0	11.0	10.0	12.0	13.0	10.0	10.0	9.0	10.0	9.0	11.0	9.0	10.0	9.0	8.0	8.0	6.0	10.0	10.0	9.2
23	9.0	11.0	12.0	11.0	11.0	9.0	10.0	12.0	14.0	11.0	11.0	14.0	14.0	11.0	10.0	11.0	12.0	15.0	7.0	5.0	5.0	16.0	17.0	16.0	11.4
24	14.0	10.0	12.0	13.0	15.0	17.0	18.0	18.0	21.0	18.0	19.0	20.0	19.0	10.0	17.0	22.0	21.0	22.0	23.0	20.0	21.0	21.0	12.0	3.0	16.9
25	3.0	7.0	2.0	2.0	4.0	4.0	3.0	7.0	6.0	4.0	3.0	9.0	11.0	13.0	6.0	4.0	13.0	12.0	12.0	10.0	10.0	9.0	12.0	10.0	7.3
26	12.0	15.0	10.0	9.0	9.0	12.0	14.0	15.0	12.0	14.0	9.0	16.0	18.0	16.0	16.0	17.0	17.0	14.0	14.0	10.0	10.0	13.0	13.0	14.0	13.3
27	15.0	14.0	13.0	11.0	12.0	13.0	16.0	18.0	18.0	18.0	23.0	27.0	28.0	26.0	28.0	26.0	26.0	27.0	24.0	23.0	20.0	22.0	22.0	23.0	20.5
28	24.0	24.0	23.0	23.0	24.0	23.0	22.0	20.0	20.0	24.0	25.0	23.0	21.0	20.0	20.0	19.0	15.0	17.0	10.0	8.0	6.0	8.0	10.0	12.0	18.4
29	11.0	11.0	10.0	8.0	4.0	2.0	1.0	5.0	8.0	10.0	11.0	13.0	18.0	16.0	17.0	15.0	13.0	15.0	13.0	12.0	12.0	8.0	11.0	8.0	10.5
30	7.0	9.0	12.0	11.0	11.0	11.0	9.0	5.0	8.0	10.0	11.0	12.0	11.0	10.0	7.0	6.0	10.0	6.0	5.0	4.0	5.0	5.0	4.0	1.0	7.9
AVG.	10.4	10.4	10.1	10.8	11.1	11.8	11.2	12.0	12.7	13.4	13.5	15.1	15.2	14.1	13.7	13.8	14.1	13.6	11.8	11.0	10.2	9.8	10.4	9.9	

# of Valid Hours = 720 % Data Completeness = 100.0

BISON ENGINEERING INC.
HELENA, MONTANA

APRIL 1991

*** *WIND DIRECTION SUMMARY* ***

HOURS

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	268	238	222	215	209	216	206	200	207	195	214	209	203	188	282	275	283	262	250	221	244	225	246	244	224.9
2	246	238	229	235	235	232	218	220	216	211	219	238	248	274	264	259	279	283	331	264	272	258	265	245	243.4
3	253	238	233	225	241	238	247	259	278	280	271	279	280	260	254	258	260	232	222	219	219	216	213	213	252.9
4	216	221	212	222	219	208	215	215	211	208	206	204	212	218	215	211	216	221	218	213	212	218	218	213	230.0
5	213	219	214	209	215	214	211	211	210	206	205	204	205	204	203	214	235	251	281	284	274	273	273	275	232.5
6	269	269	276	247	278	292	84	68	27	22	102	261	291	267	260	270	261	235	212	216	43	129	221	233	303.7
7	256	241	155	323	319	261	207	62	66	113	165	78	1	5	101	194	244	255	254	236	253	256	259	256	11.0
8	246	240	241	246	240	246	249	258	254	256	264	261	261	255	245	253	262	243	254	240	249	226	228	234	359.2
9	218	247	204	222	225	206	215	215	212	212	210	210	207	208	270	279	276	267	273	257	278	180	284	310	348.0
10	212	284	254	257	262	263	265	265	262	256	260	259	257	249	259	258	257	260	263	254	277	275	261	274	270.4
11	259	256	255	257	256	253	247	219	216	153	90	87	90	90	82	74	71	71	69	72	66	65	65	65	77.2
12	69	74	74	82	85	86	81	77	72	76	68	75	86	90	88	87	95	86	67	68	27	33	68	64	78.3
13	34	45	46	79	60	74	63	32	350	43	40	337	38	7	314	240	237	240	126	187	4	246	230	90	71.6
14	40	338	238	263	257	236	239	228	228	225	240	234	241	240	261	265	278	53	31	6	55	22	320	12	39.1
15	29	296	349	350	72	68	225	37	46	52	39	30	44	42	87	57	65	89	94	86	67	54	54	53	45.4
16	48	47	50	52	52	54	55	58	61	69	69	69	71	69	61	61	68	79	80	78	74	79	81	76	48.1
17	70	72	73	68	61	73	82	90	87	82	75	76	69	71	70	67	70	73	48	38	37	48	48	46	49.8
18	68	49	46	37	29	59	58	33	60	67	70	77	92	97	88	86	99	89	88	88	73	44	30	36	52.2
19	14	1	229	201	215	207	220	231	51	333	17	87	92	94	93	103	99	91	77	53	354	10	271	234	62.3
20	34	71	344	285	254	251	243	220	200	204	218	244	211	298	351	83	85	76	51	31	40	61	182	245	62.8
21	7	58	186	138	342	230	224	68	90	111	82	84	100	112	114	110	114	116	109	35	279	191	231	66	111.3
22	173	210	232	250	240	243	240	221	215	205	215	239	229	244	257	252	265	261	253	222	217	221	237	247	179.4
23	246	241	252	252	250	242	239	209	203	212	211	200	189	239	216	204	209	268	254	277	236	212	214	224	222.8
24	225	237	230	213	218	208	212	205	209	209	218	233	290	299	234	209	211	215	245	285	279	281	306	298	234.5
25	18	306	317	216	231	201	239	359	15	37	203	270	267	267	338	345	271	266	264	260	272	270	271	262	285.8
26	260	257	247	256	240	262	265	264	273	275	312	270	262	267	273	275	269	249	247	243	253	256	247	240	268.0
27	246	240	236	251	248	248	248	259	254	249	255	254	254	250	255	250	242	253	258	259	253	252	246	241	247.5
28	240	248	252	248	247	245	245	250	252	260	259	264	271	270	275	284	309	287	281	266	212	241	246	264	252.4
29	260	243	237	253	256	327	190	228	322	333	329	345	346	342	355	343	314	354	357	3	351	346	334	326	335.8
30	281	243	250	244	266	246	234	235	234	248	211	198	252	268	287	235	265	305	40	345	236	213	281	215	313.8

# of Valid Hours = 720 % Data Completeness = 100.0

BISON ENGINEERING INC.
HELENA, MONTANA

APRIL 1991

*** *WIND FREQUENCY SUMMARY* ***

DIR---> SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.0 - 4.0	1.0	1.0	0.8	1.4	0.7	0.3	0.4	0.3	1.0	1.1	1.7	0.8	0.7	0.4	0.8	1.1	13.5
4.0 - 7.5	0.8	1.4	1.9	0.4	0.3	0.4	0.0	0.1	0.1	0.6	1.8	1.5	1.3	1.0	0.3	0.4	12.4
7.5 - 12.1	0.3	0.4	1.8	3.2	2.9	0.7	0.0	0.0	0.0	1.9	4.4	10.3	5.1	0.3	0.6	0.6	32.5
12.1 - 19.0	0.4	0.0	1.4	3.6	2.1	0.0	0.0	0.0	0.1	2.6	2.9	5.7	5.3	0.7	0.3	0.6	25.7
19.0 - 24.7	0.0	0.0	0.0	2.1	0.7	0.0	0.0	0.0	0.0	2.6	2.5	2.9	1.7	0.1	0.0	0.0	12.6
24.7 - 30.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0	1.1	0.1	0.0	0.0	0.0	3.1
30.0 - 40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVER 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	2.5	2.8	6.0	10.8	6.7	1.4	0.4	0.4	1.3	10.8	13.3	22.4	14.2	2.5	1.9	2.6	
AVG. SPEED	6.7	5.4	8.5	13.1	12.2	7.6	2.0	3.0	4.0	16.9	12.0	13.4	13.2	9.9	6.6	7.3	

Calm Hours = 0.0%

Total Hours With Both Speed and Direction = 720

Average Wind Speed = 12.1 (MPH)

Resultant Windspeed = 4.9 (MPH)

Resultant Wind Direction = 239.3 Deg

Wind Persistance = 40.5 %

BISON ENGINEERING INC.
HELENA, MONTANA

MAY 1991

*** *WIND SPEED SUMMARY* ***

HOURS

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	11.0	16.0	19.0	21.0	20.0	20.0	18.0	18.0	17.0	16.0	14.0	14.0	18.0	17.0	21.0	11.3
2	21.0	18.0	15.0	16.0	17.0	18.0	19.0	20.0	19.0	17.0	17.0	16.0	18.0	20.0	18.0	17.0	16.0	14.0	16.0	17.0	16.0	16.0	14.0	14.0	17.0
3	12.0	11.0	9.0	11.0	11.0	12.0	13.0	14.0	13.0	15.0	16.0	17.0	17.0	15.0	12.0	12.0	11.0	12.0	10.0	8.0	8.0	7.0	7.0	6.0	11.6
4	3.0	1.0	1.0	4.0	3.0	1.0	1.0	2.0	3.0	3.0	5.0	6.0	6.0	3.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0	5.0	3.7
5	4.0	3.0	4.0	10.0	10.0	11.0	12.0	16.0	17.0	16.0	14.0	16.0	15.0	15.0	16.0	18.0	15.0	12.0	12.0	10.0	8.0	8.0	10.0	8.0	11.7
6	10.0	12.0	7.0	2.0	5.0	8.0	7.0	14.0	7.0	5.0	7.0	7.0	5.0	12.0	8.0	7.0	10.0	15.0	10.0	12.0	9.0	7.0	7.0	8.0	8.4
7	9.0	8.0	8.0	7.0	12.0	12.0	9.0	10.0	12.0	14.0	13.0	11.0	14.0	10.0	8.0	6.0	4.0	11.0	14.0	14.0	14.0	15.0	15.0	19.0	11.2
8	19.0	14.0	11.0	7.0	6.0	8.0	6.0	10.0	10.0	10.0	15.0	23.0	22.0	22.0	23.0	27.0	28.0	20.0	12.0	7.0	7.0	10.0	14.0	14.0	14.4
9	12.0	14.0	12.0	9.0	11.0	5.0	5.0	5.0	6.0	4.0	2.0	4.0	1.0	2.0	5.0	10.0	8.0	10.0	7.0	7.0	5.0	1.0	2.0	4.0	6.3
10	4.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	8.0	8.0	8.0	18.0	20.0	20.0	18.0	17.0	18.0	15.0	13.0	10.0	6.0	7.0	11.0	8.8
11	8.0	5.0	5.0	4.0	5.0	4.0	3.0	3.0	9.0	9.0	9.0	12.0	13.0	14.0	15.0	12.0	7.0	4.0	3.0	3.0	6.0	8.0	9.0	9.0	7.5
12	11.0	9.0	12.0	12.0	10.0	10.0	10.0	11.0	14.0	18.0	18.0	20.0	19.0	18.0	20.0	27.0	21.0	18.0	20.0	21.0	22.0	21.0	22.0	27.0	17.1
13	25.0	25.0	24.0	18.0	21.0	20.0	19.0	23.0	23.0	24.0	25.0	22.0	22.0	24.0	23.0	26.0	25.0	23.0	21.0	15.0	12.0	9.0	8.0	8.0	20.2
14	8.0	4.0	6.0	3.0	6.0	5.0	3.0	3.0	4.0	6.0	8.0	11.0	10.0	11.0	11.0	13.0	12.0	8.0	8.0	4.0	5.0	4.0	4.0	4.0	6.7
15	6.0	3.0	1.0	1.0	1.0	3.0	3.0	2.0	3.0	6.0	6.0	7.0	3.0	2.0	4.0	8.0	10.0	9.0	9.0	8.0	6.0	5.0	2.0	2.0	4.6
16	4.0	4.0	3.0	1.0	1.0	3.0	3.0	5.0	6.0	7.0	12.0	15.0	17.0	18.0	19.0	19.0	20.0	21.0	20.0	17.0	15.0	15.0	12.0	6.0	11.0
17	5.0	5.0	5.0	4.0	5.0	6.0	5.0	7.0	12.0	9.0	20.0	27.0	29.0	32.0	29.0	29.0	33.0	33.0	24.0	17.0	16.0	19.0	17.0	11.0	16.6
18	8.0	5.0	10.0	9.0	5.0	5.0	10.0	11.0	13.0	15.0	19.0	17.0	24.0	24.0	22.0	27.0	22.0	13.0	18.0	13.0	13.0	17.0	14.0	7.0	14.2
19	5.0	6.0	11.0	13.0	7.0	8.0	11.0	7.0	2.0	3.0	3.0	4.0	8.0	11.0	13.0	13.0	14.0	14.0	10.0	6.0	4.0	4.0	4.0	5.0	7.8
20	4.0	3.0	5.0	3.0	2.0	2.0	8.0	14.0	19.0	21.0	17.0	14.0	12.0	11.0	8.0	11.0	16.0	11.0	6.0	4.0	7.0	4.0	6.0	5.0	8.9
21	4.0	6.0	3.0	4.0	7.0	7.0	8.0	5.0	6.0	4.0	6.0	6.0	11.0	12.0	14.0	14.0	17.0	14.0	9.0	4.0	6.0	6.0	7.0	4.0	7.7
22	4.0	4.0	4.0	5.0	2.0	4.0	2.0	2.0	3.0	5.0	11.0	13.0	16.0	15.0	16.0	17.0	17.0	17.0	17.0	12.0	8.0	5.0	4.0	4.0	8.6
23	8.0	8.0	8.0	7.0	11.0	8.0	10.0	10.0	11.0	5.0	6.0	7.0	7.0	8.0	11.0	4.0	-	-	-	-	-	-	-	-	8.1
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG.	8.5	7.4	7.2	6.6	7.0	7.0	7.3	8.6	9.4	10.2	11.9	13.1	14.3	14.7	14.8	15.6	15.7	14.5	12.8	10.5	9.8	9.5	9.4	9.2	

# of Valid Hours = 544

% Data Completeness = 73.1

BISON ENGINEERING INC.
HELENA, MONTANA

MAY 1991

*** WIND DIRECTION SUMMARY ***

DAY	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	218	88	343	360	31	-	64	51	12	66	71	71	72	75	73	78	83	87	92	101	91	70	57	69	73.1
2	78	65	53	41	50	51	53	55	53	59	57	59	59	63	59	59	59	61	60	65	65	63	61	60	65.6
3	69	68	67	78	84	82	71	68	69	71	72	73	72	72	77	72	68	67	69	58	40	29	38	26	65.7
4	343	68	165	213	234	211	149	100	185	241	174	226	279	325	290	328	35	341	328	290	212	195	61	350	257.9
5	285	229	311	253	253	245	234	215	201	198	215	264	263	272	271	233	250	236	229	236	239	259	256	248	247.7
6	245	224	291	95	316	288	277	288	3	61	36	57	299	215	187	2	317	238	202	207	207	215	236	243	250.6
7	235	240	244	246	246	254	240	219	223	264	278	212	253	198	205	175	201	225	227	231	218	210	206	218	240.9
8	218	209	205	55	252	164	83	70	93	93	177	224	224	232	228	210	225	260	240	202	223	236	221	227	230.9
9	203	215	226	227	232	246	244	230	255	309	201	238	210	143	250	255	247	262	250	255	263	225	266	217	240.8
10	224	37	12	16	41	34	62	357	353	8	11	26	62	62	56	56	66	63	61	61	47	30	27	40	261.1
11	43	47	345	342	16	335	278	322	15	2	13	51	55	64	68	105	200	170	43	43	246	242	245	242	68.7
12	225	241	222	219	217	224	247	266	236	222	214	228	235	252	236	200	219	269	240	213	214	217	214	213	138.9
13	210	201	213	231	223	221	221	210	210	207	203	214	220	209	218	208	207	211	215	228	220	245	233	239	135.5
14	283	279	207	212	227	214	216	49	56	52	19	52	75	101	60	13	359	325	286	290	338	56	92	100	114.5
15	348	92	115	135	316	242	213	182	194	250	245	252	285	344	72	61	64	67	72	48	30	44	105	207	112.6
16	237	238	348	345	147	18	43	56	52	58	72	66	59	66	68	67	66	68	67	65	70	63	57	51	108.1
17	357	349	10	61	70	89	103	92	82	84	70	67	64	63	65	59	65	68	64	82	78	62	84	92	101.6
18	123	141	66	61	81	65	62	68	68	63	67	58	79	71	60	66	78	189	206	218	207	209	215	246	102.7
19	218	238	244	237	308	250	219	106	59	336	322	49	49	61	76	77	80	82	88	34	322	337	86	198	109.2
20	19	355	208	37	198	341	57	67	75	70	61	57	68	55	60	161	240	254	16	292	195	-	239	215	95.5
21	224	227	60	61	224	216	235	160	251	209	64	117	266	281	276	271	271	275	280	267	231	209	62	291	261.4
22	205	211	193	209	344	186	54	137	76	62	57	57	55	59	59	63	60	61	69	60	36	59	104	242	75.9
23	217	247	244	252	211	241	238	216	214	162	14	62	78	65	86	310	-	-	-	-	-	-	-	-	226.8
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

# of Valid Hours = 542 % Data Completeness = 72.8

BISON ENGINEERING INC.
HELENA, MONTANA

MAY 1991

*** *WIND FREQUENCY SUMMARY* ***

DIR---> SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.0 - 4.0	1.1	1.3	2.2	1.8	1.3	0.6	0.6	0.6	0.7	2.9	1.5	1.1	0.7	1.1	1.5	2.0	21.0
4.0 - 7.5	0.9	1.7	1.8	2.0	0.7	0.6	0.2	0.4	0.4	1.7	2.2	3.1	0.6	0.6	0.4	1.3	18.4
7.5 - 12.1	0.7	0.7	1.8	5.7	1.8	0.4	0.0	0.4	0.2	1.8	4.6	5.7	0.9	0.6	0.4	0.0	25.7
12.1 - 19.0	0.0	0.2	1.7	11.4	1.7	0.0	0.0	0.0	0.4	1.7	3.5	1.1	2.0	0.2	0.0	0.0	23.7
19.0 - 24.7	0.0	0.0	0.4	3.1	0.0	0.0	0.0	0.0	0.0	1.8	2.4	0.2	0.2	0.0	0.0	0.0	8.1
24.7 - 30.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	1.5	0.2	0.0	0.0	0.0	0.0	0.0	2.6
30.0 - 40.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVER 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	2.8	3.9	7.9	25.6	5.5	1.5	0.7	1.3	1.7	11.4	14.3	11.2	4.4	2.4	2.2	3.3	
AVG. SPEED	5.3	5.5	8.8	14.5	9.7	5.6	2.5	4.6	6.7	12.7	12.4	8.6	11.3	6.0	4.7	3.6	

Calm Hours = 0.0%

Total Hours With Both Speed and Direction = 544

Average Wind Speed = 10.6 (MPH)

Resultant Windspeed = 1.4 (MPH)

Resultant Wind Direction = 120.3 Deg

Wind Persistance = 12.9 %

BISON ENGINEERING INC.
HELENA, MONTANA

MAY 1991

*** *WIND FREQUENCY SUMMARY* ***

DIR---> SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.0 - 4.0	1.1	1.3	2.2	1.8	1.3	0.6	0.6	0.6	0.7	2.9	1.5	1.1	0.7	1.1	1.5	2.0	21.0
4.0 - 7.5	0.9	1.7	1.8	2.0	0.7	0.6	0.2	0.4	0.4	1.7	2.2	3.1	0.6	0.6	0.4	1.3	18.4
7.5 - 12.1	0.7	0.7	1.8	5.7	1.8	0.4	0.0	0.4	0.2	1.8	4.6	5.7	0.9	0.6	0.4	0.0	25.7
12.1 - 19.0	0.0	0.2	1.7	11.4	1.7	0.0	0.0	0.0	0.4	1.7	3.5	1.1	2.0	0.2	0.0	0.0	23.7
19.0 - 24.7	0.0	0.0	0.4	3.1	0.0	0.0	0.0	0.0	0.0	1.8	2.4	0.2	0.2	0.0	0.0	0.0	8.1
24.7 - 30.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	1.5	0.2	0.0	0.0	0.0	0.0	0.0	2.6
30.0 - 40.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVER 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	2.8	3.9	7.9	25.6	5.5	1.5	0.7	1.3	1.7	11.4	14.3	11.2	4.4	2.4	2.2	3.3	
AVG. SPEED	5.3	5.5	8.8	14.5	9.7	5.6	2.5	4.6	6.7	12.7	12.4	8.6	11.3	6.0	4.7	3.6	

Calm Hours = 0.0%

Total Hours With Both Speed and Direction = 544

Average Wind Speed = 10.6 (MPH)

Resultant Windspeed = 1.4 (MPH)

Resultant Wind Direction = 120.3 Deg

Wind Persistance = 12.9 %

JUNE 1991

*** WIND SPEED SUMMARY ***

DAY	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.0	3.0	4.0	3.0	3.0	4.0	3.3
6	9.0	4.0	3.0	6.0	6.0	3.0	4.0	5.0	4.0	6.0	9.0	12.0	13.0	13.0	15.0	15.0	17.0	15.0	9.0	11.0	9.0	3.0	3.0	6.0	8.3
7	4.0	4.0	5.0	5.0	12.0	10.0	8.0	11.0	13.0	11.0	9.0	11.0	11.0	10.0	12.0	18.0	12.0	14.0	12.0	10.0	11.0	10.0	10.0	5.0	9.9
8	4.0	2.0	4.0	7.0	3.0	2.0	1.0	6.0	6.0	5.0	6.0	6.0	11.0	15.0	15.0	12.0	11.0	17.0	15.0	13.0	15.0	10.0	8.0	8.0	8.4
9	10.0	9.0	6.0	5.0	6.0	3.0	8.0	13.0	19.0	14.0	10.0	9.0	13.0	14.0	15.0	12.0	10.0	7.0	4.0	2.0	5.0	8.0	4.0	2.0	8.7
10	3.0	4.0	1.0	4.0	5.0	4.0	4.0	10.0	13.0	10.0	15.0	12.0	10.0	16.0	18.0	17.0	17.0	14.0	12.0	11.0	7.0	9.0	3.0	4.0	9.3
11	4.0	3.0	2.0	4.0	6.0	8.0	9.0	9.0	16.0	20.0	21.0	23.0	25.0	29.0	28.0	25.0	25.0	17.0	16.0	9.0	8.0	5.0	6.0	3.0	13.4
12	3.0	4.0	4.0	5.0	2.0	1.0	2.0	3.0	3.0	4.0	5.0	5.0	6.0	7.0	6.0	4.0	2.0	3.0	3.0	9.0	7.0	9.0	7.0	5.0	4.5
13	3.0	3.0	4.0	5.0	4.0	3.0	4.0	4.0	5.0	4.0	6.0	4.0	4.0	5.0	6.0	6.0	9.0	12.0	16.0	13.0	11.0	10.0	7.0	7.0	6.5
14	6.0	4.0	5.0	5.0	5.0	4.0	4.0	9.0	9.0	7.0	10.0	9.0	13.0	15.0	12.0	16.0	16.0	15.0	13.0	9.0	7.0	7.0	7.0	10.0	9.0
15	11.0	10.0	9.0	8.0	11.0	12.0	11.0	13.0	10.0	7.0	7.0	10.0	10.0	8.0	7.0	12.0	17.0	16.0	13.0	11.0	12.0	10.0	8.0	11.0	10.6
16	7.0	6.0	6.0	5.0	5.0	10.0	10.0	13.0	12.0	17.0	15.0	13.0	8.0	13.0	10.0	11.0	14.0	9.0	4.0	4.0	2.0	3.0	3.0	4.0	8.5
17	3.0	6.0	5.0	14.0	12.0	8.0	12.0	13.0	10.0	18.0	21.0	25.0	30.0	25.0	21.0	25.0	21.0	14.0	9.0	7.0	4.0	4.0	3.0	4.0	13.1
18	2.0	2.0	4.0	2.0	2.0	2.0	2.0	2.0	5.0	7.0	8.0	11.0	14.0	15.0	15.0	17.0	19.0	20.0	17.0	12.0	7.0	7.0	13.0	14.0	9.1
19	11.0	6.0	6.0	7.0	5.0	5.0	7.0	12.0	10.0	12.0	14.0	18.0	22.0	24.0	25.0	24.0	25.0	24.0	26.0	23.0	21.0	18.0	18.0	19.0	15.9
20	15.0	16.0	15.0	12.0	12.0	14.0	15.0	14.0	16.0	17.0	18.0	20.0	12.0	23.0	21.0	22.0	24.0	23.0	22.0	17.0	13.0	9.0	6.0	4.0	15.8
21	2.0	3.0	6.0	8.0	9.0	7.0	6.0	4.0	4.0	5.0	10.0	9.0	10.0	17.0	20.0	18.0	14.0	13.0	9.0	7.0	5.0	10.0	17.0	18.0	9.6
22	18.0	16.0	14.0	7.0	5.0	5.0	5.0	5.0	3.0	4.0	4.0	4.0	4.0	7.0	6.0	5.0	5.0	11.0	10.0	6.0	3.0	7.0	5.0	4.0	6.8
23	5.0	3.0	2.0	2.0	6.0	5.0	7.0	10.0	13.0	8.0	6.0	6.0	8.0	10.0	11.0	12.0	8.0	10.0	8.0	6.0	6.0	4.0	3.0	1.0	6.7
24	3.0	3.0	1.0	3.0	5.0	3.0	5.0	3.0	5.0	5.0	4.0	4.0	7.0	14.0	17.0	13.0	11.0	8.0	9.0	10.0	6.0	5.0	12.0	13.0	7.0
25	9.0	6.0	9.0	12.0	11.0	5.0	4.0	6.0	10.0	8.0	17.0	17.0	14.0	18.0	18.0	17.0	15.0	14.0	11.0	16.0	13.0	16.0	13.0	13.0	12.2
26	10.0	9.0	7.0	10.0	10.0	13.0	10.0	11.0	11.0	7.0	8.0	8.0	17.0	15.0	15.0	21.0	12.0	10.0	12.0	9.0	7.0	11.0	12.0	11.0	11.1
27	11.0	13.0	14.0	12.0	6.0	6.0	11.0	13.0	11.0	6.0	4.0	8.0	13.0	14.0	17.0	16.0	16.0	8.0	3.0	4.0	4.0	7.0	3.0	2.0	9.3
28	3.0	10.0	7.0	5.0	14.0	12.0	10.0	10.0	18.0	16.0	18.0	15.0	17.0	17.0	16.0	13.0	11.0	11.0	10.0	8.0	4.0	2.0	4.0	3.0	10.6
29	1.0	3.0	2.0	2.0	3.0	3.0	5.0	3.0	3.0	4.0	3.0	5.0	2.0	5.0	7.0	9.0	6.0	14.0	17.0	16.0	16.0	12.0	9.0	9.0	6.6
30	6.0	6.0	7.0	7.0	15.0	17.0	18.0	16.0	14.0	15.0	16.0	16.0	16.0	16.0	17.0	17.0	18.0	15.0	13.0	17.0	16.0	11.0	12.0	18.0	14.1
AVG.	6.5	6.2	5.9	6.5	7.2	6.6	7.3	8.7	9.7	9.5	10.6	11.2	12.4	14.6	14.8	15.1	14.2	13.4	11.4	10.1	8.6	8.1	7.7	7.8	

# of Valid Hours = 606 % Data Completeness = 84.2

BISON ENGINEERING INC.
HELENA, MONTANA

JUNE 1991

*** WIND DIRECTION SUMMARY ***

DAY	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG.
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	45	2	34	99	19	34.0
6	36	183	267	192	221	236	271	36	43	44	57	50	56	49	71	73	71	61	60	85	80	73	105	76	73.5
7	163	229	25	204	219	205	215	233	276	247	295	262	276	285	250	219	272	280	277	274	266	241	280	305	241.5
8	195	207	226	232	161	33	37	236	236	267	255	272	278	272	266	262	228	207	212	219	235	239	247	246	239.8
9	240	229	204	253	294	184	317	290	283	288	279	252	261	258	258	264	307	318	67	24	211	219	244	89	252.4
10	29	356	104	17	36	23	96	199	220	211	203	213	187	265	282	280	289	284	281	270	222	222	43	266	262.8
11	9	338	18	5	52	225	232	235	219	206	201	200	199	206	207	218	217	284	344	359	19	63	56	50	230.7
12	94	189	196	202	14	358	71	98	94	92	69	72	43	60	351	358	337	271	43	60	64	319	54	74	208.7
13	62	90	38	40	22	349	31	296	326	62	60	106	116	232	32	29	44	61	61	67	55	17	19	38	338.3
14	16	50	329	216	333	155	77	269	289	2	305	277	240	256	228	271	271	267	261	254	249	252	253	238	317.4
15	242	245	245	241	246	249	230	219	215	273	298	289	282	256	281	249	230	233	224	208	213	216	261	272	257.0
16	115	92	13	118	98	174	182	195	236	268	263	266	14	354	359	320	3	356	293	1	59	116	227	213	237.4
17	186	346	171	277	294	288	257	274	312	269	279	275	276	279	281	283	281	289	262	248	8	250	211	184	266.7
18	184	193	347	135	20	219	67	114	57	64	66	56	54	52	54	54	63	68	65	42	47	31	79	81	70.3
19	66	112	42	10	42	324	16	43	35	71	57	59	65	71	78	81	76	76	78	77	77	66	75	71	68.6
20	77	83	67	68	81	70	71	78	82	80	71	72	45	46	45	43	52	41	41	33	28	21	47	35	67.0
21	1	167	199	207	207	218	209	211	9	11	31	34	37	43	45	37	15	35	17	6	356	23	49	48	48.8
22	50	44	46	38	1	355	24	7	190	139	260	133	129	49	357	242	187	336	319	49	232	193	69	220	101.1
23	182	156	238	223	199	42	209	142	183	96	16	43	42	29	61	49	2	11	1	261	13	70	5	346	130.9
24	176	182	181	180	187	256	179	215	223	181	222	344	314	257	265	278	280	337	351	348	335	26	260	260	227.5
25	272	263	270	271	233	254	194	256	208	247	277	273	279	272	211	212	223	243	233	215	219	219	247	229	244.4
26	216	205	229	230	229	213	205	200	204	224	292	312	263	267	276	269	243	202	219	240	226	225	211	217	229.9
27	207	207	206	203	256	305	206	204	196	223	6	62	57	57	66	62	74	110	245	208	118	20	38	199	188.4
28	220	248	266	338	217	230	219	240	211	209	215	214	214	225	214	270	252	268	249	270	87	209	194	245	213.9
29	151	6	359	30	138	183	39	83	58	59	18	283	339	301	313	278	303	208	209	209	260	272	239	235	219.3
30	238	244	221	242	263	264	259	266	271	259	274	260	242	248	239	255	249	239	219	214	210	248	264	273	250.2

# of Valid Hours = 606 % Data Completeness = 84.2

BISON ENGINEERING INC.
HELENA, MONTANA

JUNE 1991

**** WIND FREQUENCY SUMMARY ****

DIR---> SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.0 - 4.0	2.3	2.3	1.8	1.8	1.7	1.2	0.8	1.0	2.0	2.0	1.8	1.0	0.8	0.3	0.0	1.2	21.9
4.0 - 7.5	1.7	2.1	3.1	1.8	0.3	0.5	0.0	0.0	1.0	1.7	2.3	2.1	1.2	0.8	1.2	0.8	20.6
7.5 - 12.1	1.2	1.5	2.0	1.7	0.7	0.2	0.2	0.0	0.5	3.1	4.3	4.6	4.6	1.3	1.3	0.5	27.6
12.1 - 19.0	0.3	0.5	2.3	4.1	0.7	0.0	0.0	0.0	0.2	3.3	3.0	2.5	5.9	1.3	0.0	0.2	24.3
19.0 - 24.7	0.0	0.0	1.2	1.2	0.2	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.7	0.0	0.0	0.0	3.6
24.7 - 30.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.0	0.5	0.2	0.0	0.0	2.0
30.0 - 40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVER 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	5.4	6.4	10.4	11.1	3.5	1.8	1.0	1.0	3.6	11.1	11.7	10.2	13.7	4.0	2.5	2.6	
AVG. SPEED	5.9	6.3	10.3	12.3	8.1	4.3	4.5	3.0	5.0	11.3	10.0	9.8	12.9	11.0	7.9	5.7	

Calm Hours = 0.0%

Total Hours With Both Speed and Direction = 606

Average Wind Speed = 9.7 (MPH)

Resultant Windspeed = 2.0 (MPH)

Resultant Wind Direction = 264.1 Deg

Wind Persistance = 21.0 %

BISON ENGINEERING INC
HELENA, MONTANA

Envircon Livingston, Montana 2nd Q 1991

*** *WIND FREQUENCY SUMMARY* ***

DIR---> SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.0 - 4.0	1.4	1.5	1.6	1.7	1.2	0.6	0.6	0.6	1.2	1.9	1.7	1.0	0.7	0.6	0.7	1.4	18.4
4.0 - 7.5	1.1	1.7	2.3	1.3	0.4	0.5	0.1	0.2	0.5	1.2	2.1	2.2	1.0	0.8	0.6	0.8	16.8
7.5 - 12.1	0.7	0.9	1.9	3.4	1.9	0.4	0.1	0.1	0.2	2.3	4.4	7.1	3.7	0.7	0.7	0.4	28.9
12.1 - 19.0	0.3	0.2	1.8	6.0	1.5	0.0	0.0	0.0	0.2	2.6	3.1	3.3	4.5	0.7	0.1	0.3	24.7
19.0 - 24.7	0.0	0.0	0.5	2.1	0.3	0.0	0.0	0.0	0.0	1.7	1.7	1.2	0.9	0.1	0.0	0.0	8.4
24.7 - 30.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.2	0.2	0.4	0.2	0.1	0.0	0.0	2.6
30.0 - 40.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVER 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	3.5	4.3	8.0	15.2	5.3	1.6	0.7	0.9	2.1	11.1	13.1	15.2	11.2	2.9	2.2	2.8	
AVG. SPEED	6.0	5.9	9.3	13.6	10.6	5.8	3.3	3.7	5.1	13.8	11.6	11.6	12.9	9.5	6.5	5.6	

Calm Hours = 0.0%

Total Hours With Both Speed and Direction = 1870

Average Wind Speed = 10.9 (MPH)

Resultant Windspeed = 2.3(MPH)

Resultant Wind Direction = 237.5Deg

Wind Persistance = 21.1 %

APPENDIX B

ENVIROCON, INC.

BISON ENGINEERING/RESEARCH
Helena, Montana

Total Suspended Particulate - Calibration

Calibrated by Dan Dartman Location Livingston Railyard

Date 6-20-91 Sampler # Downwind

Calibration Equation: $Qr = .49134\ (dP)^{.49610}$

Run	Plate No.	P1 (left)	P2 (right)	dP (total)	TR	Qr^*	Qr^+
1	18	3.5	3.7	7.2	44.2	1.308	1.172
2	13	2.2	2.1	4.3	37.0	1.013	1.062
3	10	2.3	2.4	4.7	37.0	1.059	1.062
4	7	1.4	1.6	3.0	32.0	0.847	0.985
5	5	0.8	1.1	1.7	6.0	0.639	0.586

Qr^* = flow rate by Orifice equation

Qr^+ = flow rate from transducer regression equation

Results--

Slope = 0.0154 Intercept = 0.4934 Corr. Coeff. = 0.9102

Qr = a(TR) + b = 0.0154 (TR) + 0.4934

BISON ENGINEERING INC

Helena, Montana

Total Suspended Particulate - Audit

Audited by Jack Dartman Company Livingston Railyard

Date 6-20-91 Project 0482

Audit Equation: $Qr = .62283\ (dP)^{.48645}$

Sample #	Plate No.	P1 (left)	P2 (right)	dP (total)	TR	Qr^{*}	Qr^{+}
1	VO	1.5	1.7	3.2	37.5	1.097	1.068
	VO						
	VO						
	VO						
	VO						

Qr^{*} = flow rate by Audit Equation

Qr^{+} = flow rate from previous calibration equation

Results:

Sampler #	% Difference
1	-2.6 %
	%
	%
	%
	%

BISON ENGINEERING INC

Helena, Montana

PM-10 Calibration - Wedding Assoc.

Calibrated by Dan Dartman

Location Livingston Railyard

Date 6-20-91

Sampler # Upwind (Track)

Look-up :

20" U-Tube Manometer: 20.9 " Water = delta

Barometric Pressure : 25.31 " Mercury = P0

Temperature: 65 F

P1/P0 = 0.939 {P1=P0 - delta/13.6

Look-up = 40.166 = Look-ACFM

Look-SCFM = 34.755 (std ft^3/min)

= ACFM[P0*298]/29.92*Tk] Tk=temp degrees K

Orifice:

10 " Manometer 4.2 " (Clean Filter)

$$Q = .49134\,(dP)^{.49610}$$

= 1.001 (m^3/min)

Qcfm = Q*35.314

= 35.361 (acfm)r

$$Qscfm = Qcfm[(P0*298)/(29.92*Tk)]^{0.5}$$

= 32.893

% Difference: 5.7 %

Adjustment: __________ (if necessary)

Clean Filter Transducer: __________ acfm

BISON ENGINEERING INC

Helena, Montana

PM-10 Auditing - Wedding Assoc.

Audited by Jack Dartman Location Livingston Railyard

Date 6-20-91 Sampler # Upwind (Track)

Look-up :

P1/P0 = 0.939 (from previous calibration)

Temperature: 291 K (degrees K)

Look-up = 40.141 = Look-ACFM

Look-SCFM = 34.733 (std ft^3/min)

= ACFM[P0*298]/29.92*Tk] Tk=temp degrees K

Audit Orifice

10 " Manometer 2.8 " (Clean Filter)

$$Q = .62283\ (dP)^{.48645}$$

= 1.028 (m^3/min)

Qcfm = Q*35.314

= 36.294 (acfm)r

$$Qscfm = Qcfm[(P0*298)/(29.92*Tk)]^{0.5}$$

= 33.761

$$Qacfm = Qcfm[(P0*298)/(29.92*Tk)]^{-0.5}$$ = 39.071

Clean Filter Trans. ________

% Difference: 2.9 % (from SCFM)

% Difference: -2.5 % (from 40 ACFM)

BISON ENGINEERING INC

Helena, Montana

PM-10 Calibration - Wedding Assoc.

Calibrated by Dan Dartman Location Livingston Railyard

Date 6-20-91 Sampler # Downwind, Met.

Look-up :

20" U-Tube Manometer: 19.2 " Water = delta

Barometric Pressure : 25.31 " Mercury = P0

Temperature: 65 F

P1/P0 = 0.944 {P1=P0 - delta/13.6

Look-up = 40.259 = Look-ACFM

Look-SCFM = 34.836 (std ft^3/min)

= ACFM[P0*298]/29.92*Tk] Tk=temp degrees K

Orifice:

10 " Manometer 4.1 " (Clean Filter)

$$Q = .49134\,(dP)^{.49610}$$

= 0.989 (m^3/min)

Qcfm = Q*35.314

= 34.941 (acfm)r

$$Qscfm = Qcfm[(P0*298)/(29.92*Tk)]^{0.5}$$

= 32.502

% Difference: 7.2 %

Adjustment: ______ (if necessary)

Clean Filter Transducer: ______ acfm

BISON ENGINEERING INC

Helena, Montana

PM-10 Auditing - Wedding Assoc.

Audited by Jack Dartman Location Livingston Railyard

Date 6-20-91 Sampler # Downwind, Met.

Look-up :

P1/P0 = 0.944 (from previous calibration)

Temperature: 291 K (degrees K)

Look-up = 40.243 = Look-ACFM

Look-SCFM = 34.821 (std ft^3/min)

= ACFM[P0*298]/29.92*Tk] Tk=temp degrees K

Audit Orifice

10 " Manometer 2.8 " (Clean Filter)

$$Q = .62283\ (dP)^{.48645}$$

= 1.028 (m^3/min)

Qcfm = Q*35.314

= 36.294 (acfm)r

$$Qscfm = Qcfm[(P0*298)/(29.92*Tk)]^{0.5}$$

= 33.761

$$Qacfm = Qcfm[(P0*298)/(29.92*Tk)]^{-0.5} = 39.017$$

Clean Filter Trans. ______

% Difference: 3.1 % (from SCFM)

% Difference: -2.5 % (from 40 ACFM)

B I S O N   E N G I N E E R I N G   I N C

Helena, Montana

Meteorological Montitoring System
Met One

Audit

Performed by J. Dartman
Location Livingston Railyard

Date June 20, 1991
Serial #: Met One

East/West Theodolite Position

Vertical Alignment of Wind Speed: OK

Vertical Alignment of Wind Direction: OK

Cross Arm East/West: OK

Indicated North: 0.25 degrees

North/South Theodolite Position

Vertical Alignment of Wind Speed: OK

Vertical Alignment of Wind Direction: OK

Cross Arm Horizontal: OK

Wind Vane

	DAS	Strip Chart
0/360	10	---
90	96	---
180	195	---
270	288	---

Wind Speed

		DAS	Strip Chart
	0	0.9	---
(Sync. Motor)	18.2	18.7	---
(Sync. Motor)	9.1	9.8	---

Comments: High gusty winds during audit.